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The Journal of Educational Psychology

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THE JOURNAL OF
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MENTAL DISCIPLINE IN HIGH SCHOOL STUDIES[1]

E. L. THORNDIKE

With the aid of the staff of The Institute of Educational Research,

Teachers College, Columbia University

The experiment to be reported consisted of an examination in May, 1922, and a reexamination in May, 1923, of 8564 pupils who, in May, 1922, were in grades IX, X and XI. The two examinations were alternative forms of a composite of tests of "general intelligence" that are in common use, plus certain ones added in order to have measures with spatial as well as verbal and numerical content. This composite examination is that described in Vol. V, No. 4 of the *Journal of Educational Research*, April, 1922. Each pupil who took both examinations recorded the subjects which he studied during the school year Sept. 22, 1922 to June 23, 1923; and the gains made in the test were put into relation with the subjects studied. For example, we compare the gains for the pupils who studied English, history, geometry and Latin during the year with the gains for the pupils who studied English, history, geometry and shop-work. If other factors such as initial ability, zeal in taking the examination, and special training on its content are properly equalized or allowed for, the difference in gain represents the difference between Latin and shop-work as taught in these schools in general training or disciplinary value or improvement in "general intelligence," or whatever a gain in such an examination measures.

We shall report the procedures and results only in so far as is necessary to enable the reader to estimate their validity. Even so the report has to be long and somewhat elaborate. The reader needs to know how the pupils were selected; by whom and how the examinations were given and how far the pupils tried to do the best they could;

[1] This investigation was made possible by a grant from the Commonwealth Fund.

what abilities the examinations measured; what weight the scoring system attached to each of the tests and to various combinations from among them; what the difference in difficulty of the two forms was, and what allowance was made therefor; and how nearly the pupils' reports of subjects taken corresponded with the subjects which they actually had taken during the year.

He needs to know our procedure in treating certain possibly disturbing factors, such as the unreliability or variable error of the examination itself, the inequality of units of the examination scores (whereby, for example, a gain from 200 to 210 might represent a greater real increment of ability than a gain from 100 to 110), or a relation of gain to grade and of subject to grade productive of an irrelevant relation (whereby, for example, trigonometry by being given in Grade XI or XII might suffer in comparison with geometry given in Grade X), or a relation of gain to initial ability. In all these matters the essential desideratum is to preserve equality of conditions between one study and another in all respects save those produced by taking the study.

The Subjects

The subjects were pupils reporting themselves in Grades IX, X and XI in May, 1922, who took the test in May, 1923 also. The three grade groups are designated in what follows as A, B and C respectively. Apart from errors in their reports, cases of failure of promotion, and double promotion, an A had the training of Grade X, a B that of grade XI, and a C that of Grade XII. These grade distinctions will be found to be of little importance for us, and in our final reckoning no distinction will be made between, say, Latin taken by an A, and Latin taken by a C.

The distribution among cities and schools of those measured in 1922 and also in 1923 was as shown in Table I.

TABLE I.—INVENTORY OF PUPILS MEASURED IN 1922 AND 1923

City	School	A Work of Grade X			B Grade XI			C Grade XII		
		1922	1922–1923	1923 only	1922	1922–1923	1923 only	1922	1922–1923	1923 only
4	4	....	....	....	130	96	...	48	29	
5	5	77	67	....	51	38	...	59	55	
6	6	95	79	....	73	60	...	71	58	
7	7	52	41	....	32	23	...	58	43	
8	8	51	27	104	60	43	89	64	47	85
9	9	371	62	....	261	187	...	173	128	
10	10	182	119	....	139	89	...	89	66	
11	11	94	60	....	85	68	...	37	33	
1	12	669	574	131	613	487	86	549	454	70
	13	627	407	59	428	336	56	342	276	45
	14	374	198	78	313	184	53	211	155	33
	15	638	477	38	581	446	20	429	322	21
2	21	199	123	....	202	143	...	148	109	
	22	246	69	....	244	164	...	286	200	
	23	591	356	744	473	312	267	392	263	184
	24	66	28	....	413	295	...	403	275	
	25	14	11	....	206	165	...	185	125	
	26	127	92							
		4473	2790	1154	4304	3136	571	3544	2638	438

THE EXAMINATION

The examinations were, as stated, Forms A and B of the I. E. R. Test of Selective and Relational Thinking, called hereinafter Sel. A and Sel. B, and the I. E. R. Test of Generalization and Organization, called hereinafter Gen. A and Gen. B. Pupils in certain schools took Sel. A and Gen. A in 1922 and Sel. B and Gen. B in 1923. Pupils in other schools took Sel. B and Gen. B in 1922 and Sel. A and Gen. A in 1923. These were as described in the *Journal of Educational Research*, Vol. V, pp. 273–278, with misprints corrected and with a few modifications of certain elements suggested by preliminary experimentation. The reader will be able to identity them from the titles and sample lines of Table II.

This composite of 15 tests was intended to meet three requirements. First, it should give a measure of so-called "general intelligence," or whatever is measured by Stanford-Binet, Otis, National, Terman, Haggerty, Thorndike, and other similar tests. That it meets this requirement is almost guaranteed by the fact that its components are (except for Sel. 3) these used in such instruments, and is proved by the fact that its correlation with the Terman Test for Grade IX to XII is substantially as close as its own self correlation.[1]

Second, it should permit some analysis of any disciplinary effects into effects *via* form and effects *via* content. To this end Sel. 6, 7 and 8 are all of the analogies or mixed relations form, but with spatial, grammatical and word-meaning contents. Gen. 2, 3 and 4 are all of the common element form used by Otis, but with word meanings, pictures, and numbers as content. Sel. 5 is a number-completion and Gen. 5 is a sentence-completion test. In general, we set off Tests Sel. 2, 4, 7, and 8 and Gen. 1, 2, and 5 as primarily word-meaning tests, Tests Sel. 1 and 5 and Gen. 4 and 7 as primarily numerical, and Tests Sel. 3 and 6 and Gen. 3 and 6 as distinctively spatial.

Third, it should give a just, or even more than just, representation of those intellectual abilities which the studies of alleged general benefit to the intellect are most likely to improve. The tasks included in our tests are not taken at random from the tasks of intellect in the world. For example, the content is nowhere three-dimensional, never involves tastes or smells, and has no social or political situations to be responded to. Words, numbers, and space forms are clearly favored in comparison with, say, persons, plants and dynamic relations. The composite favors linguistic and mathematical abilities, as do almost all of our stock instruments for measuring intelligence. This restriction to abilities somewhat closely allied to those specifically trained in studying languages and mathematics seemed wise. If the training in question does not spread to these abilities it cannot be expected to improve a pupil's thinking about personal hygiene, family adjustments, or public policies. Moreover, with our limitations of time, also, it seemed better to test in these three fields rather than to sample intellectual operations at large.

---

[1] For 209 cases, the correlation between Form A of one examination and the score in Terman (Forms A and B or, in some cases 2 and the Form B score) is .82. The correlation between Form A and Form B of our examination is .82 for 1039 boys taken at random from Grades IX, X and XI in 1922; and is .863 for 489 16-yr.-old boys in high school.

It is not, then, claimed that the composite is as good a team to measure intellect impartially as could be desired. On the contrary, certain aspects are deliberately included and others excluded. To save time, however, we shall often use the term *intellect* or *intelligence* for the ability measured by our composite examination.

Units.—A very extensive investigation was made to determine the real value of each difference in score from 80 to 300. This will be reported elsewhere. The result which concerns us is that the units of our scale are equal to a rather close approximation, so that a gain from 100 to 110 represents closely the same gain in real ability as does a gain from 110 to 120, or from 120 to 130, or from 140 to 150, and so on. Consequently, the gains in score may be treated as proportional to gains in real ability, regardless of the place on the scale at which they occur, and may be subjected to arithmetical treatment without involving us in any constant error.

The examinations were given by directors of educational measurements, principals or teachers, sometimes to very large groups, sometimes to groups of 30 or less. The instructions (quoted in Appendix I at the end of this report) were followed except for occasional slips in timing. Since these sources of error were random in respect to the studies taken by pupils, no group or individual was discarded. The examinations involve speed in the sense that very few pupils stopped work before time was up. On the other hand, the gradation of the separate tasks in difficulty is from tasks that all save a very few pupils succeed with to tasks that few or none succeed with; and almost all the pupils make numerous wrong responses. Consequently the main factor determining an individual's score is probably the degree of difficulty that he can master within a reasonable time.

The pupil could distribute the 39 minutes allowed for the Selection booklet in any way that he chose, though he was directed to begin Test 2 at the end of 10 minutes, Test 3 at the end of 4 minutes more, and so on. The same holds for the Generalization booklet. Probably the great majority of pupils followed the time schedule of the directions. A rigid division of time among tests is hard to enforce and seems likely to weaken pupils' cooperation and introduce a mora element into the score. No matter how a test booklet is printed, a pupil can, if he wishes, go back and work on a previous test instead of on the one specified. So it seems unwise to order him not to. If in 1922 as a result of the fore-exercise, or in 1923 as a result of that plus the 1922 trial, a pupil alters his score for better or worse by departures

from the suggested time schedule, this action on his part is not a bad test of his intelligence. In any case, it is only an extension of what is always permitted with respect to the separate tasks within one test when many pupils are tested together, and it is equally fair to pupils of different programs of studies.

The scoring system, shown in Table II, was devised after a study of a small sampling of the booklets so as to require a minimum of time and still give reasonable weights to each of the 15 tests and especially to the total scores in the word-meaning (W), numerical (N), and spatial (S) composites. Just how it works appears from the results for the 1039 A's, B's, and C's (males) and for the 489 16-yr.-old males in schools 12, 13, 14 and 15, who took both tests. The variabilities for W, N, and S were as shown below. These are satisfactory. The weights for the 15 tests singly are as shown in Table II.

	1039 males	489 16-yr.-old males	Average
W (Sel. 2 + 4 + 7 + 8 + Gen. 1 + 2 + 5) Form A('22)	24.85	26.01	25.43
W (Sel. 2 + 4 + 7 + 8 + Gen. 1 + 2 + 5) Form B('23)	24.21	25.49	24.85
N (Sel. 1 + 5 + Gen. 4 + 7) Form A ('22)	16.23	17.51	16.87
N (Sel. 1 + 5 + Gen. 4 + 7) Form B ('23)	20.58	19.27	19.93
S (Sel. 3 + 6 + Gen. 3 + 6) Form A ('22)	8.95	8.57	8.76
S (Sel. 3 + 6 + Gen. 3 + 6) Form B ('23)	10.36	10.14	10.25

Average W	25.14
Average N	18.40
Average S	9.50

The scores obtained in the examination vary among schools, grades, and individual pupils as shown in Tables III, IV, and V.

TABLE II.—REFERENCE TEST OF TESTS, NUMBER OF TASKS IN EACH: ALLOWANCE IN TIME SCHEDULE SCORING SYSTEM, AND RELATIVE WEIGHT

	Nature of test	Number of tasks	Allowance in time schedule	Scoring system	Relative weight (sample of 1039 cases)	
					Form A	Form B
Sel. 1	Arithmetical problems	21	10	3XR	8.2	8.1
Sel. 2	Absurdities (plan of Woodworth Wells)	16	4	1X(R − W)	3.7	3.3
Sel. 3	Constructing geometrical figures (*e.g.*, draw 5 squares using only 6 lines).	0 5	6 4	2XR in 1 and 2 4XR in 3, 4 and 5	3.2	3.3
Sel. 4	Opposites (plan of Thorndike and Wylie) (The word given must be a true opposite and also begin with a certain letter)	35	5	2XR	6.5	7.2
Sel. 5	Number completions (plan of Rogers)	20	4	1XR	4.6	4.6
Sel. 6	Geometrical analogies (plan of Thorndike).	20	4	1X score as per Thorndike Key	4.4	4.7
Sel. 7	Grammatical analogies (plan of Briggs)	32	4	1XR	4.4	4.6
Sel. 8	Word-meaning analogies (plan of Woodworth Wells but with selection of one from four responses as in Army Alpha and elsewhere)	40	4	½XR	4.9	5.0
Gen. 1	Modified Pressey Moral Distinction Test (cross out in each line the one word that does not belong there)	12	2	1XR	3.9	4.4
Gen. 2	Common feature test of Otis with words (*e.g.*, fat, grease, butter, . . . melt, lard, burn fry)	20	3	1XR	5.3	5.5
Gen. 3	Same as 2 but with pictures	20	3	2XR	3.2	3.3
Gen. 4	Same with numbers (*e.g.*, 21, 49, 700, . . . 800, 63, 12, 94)	20	3	2XR	3.2	4.5
Gen. 5	Sentence completion (Trabue)	15	10	2X score as per Trabue Key	8.9	8.8
Gen. 6	Cutting a surface to make pieces shown (Army Beta Test but with directions to cut whole to make pieces rather than to put pieces together to make whole)	10	3	1XR	2.5	2.3
Gen. 7	Equation test (Thorndike) (*e.g.*, to put 2, 3, 4, 5, 45, = + + + together to make a true equation)	20	12	2XR	6.9	8.4

TABLE III.—MEDIAN SCORES IN 1922 EXAMINATION

City	School	Exam.	A Grade IX	B Grade X	C Grade XI
4	4	A	.....	183.3	186.3
5	5	A	157.5	169.4	182.5
6	6	A	138.9	160.4	181.3
7	7	A	150.0	186.7	186.3
8	8	A	159.5	200.0	206.0
9	9	A	150.7	174.9	197.9
10	10	A	156.7	167.9	193.9
11	11	A	169.0	204.0	235.0
1	12	A	183.8	194.0	205.0
1	13	A	178.2	189.0	204.5
1	14	A	164.0	174.7	181.8
1	15	A	186.3	196.1	206.6
2	21	B	161.6	174.3	189.1
	22	B	157.5	168.0	193.2
	23	B	170.0	188.9	202.2
	24	B	160.0	202.2	205.2
	25	B	166.7	199.4	201.7
	26	B	178.6		

TABLE IV.—MEDIAN SCORES IN 1923 EXAMINATION

City	School	Exam.	Grade X		Grade XI		Grade XII	
			Examined in 22	New cases	Examined in 22	New cases	Examined in 22	New cases
4	4	B	.....		221.7		223.0	
5	5	B	206.4		224.0		217.5	
6	6	B	160.6		180.0		205.0	
7	7	B	169.2		210.0		212.1	
8	8	B	222.5	176.0	237.9	200.9	252.8	207.0
9	9	B	182.1		211.6		202.2	
10	10	B	195.2		205.0		223.8	
11	11	B	186.3		222.0		271.3	
1	12	B	210.7	211.7	228.0	199.2	236.3	224.0
1	13	B	203.2	196.9	213.2	200.0	218.2	219.0
1	14	B	194.6	163.3	204.8	185.0	208.3	201.3
1	15	B	205.1	185.0	225.7	165.0	237.5	227.5
2	21	A	187.8		196.1		206.8	
2	22	A	199.9		207.0		215.5	
2	23	A	195.2	190.3	212.1	193.3	219.5	213.7
2	24	A	188.0		225.3		228.3	
2	25	A	175.0		217.6		220.4	
2	26	A	203.3					

Also 61 cases in Grade IX in school 9 with Form A, median 140.
153 cases in Grade IX in school 9 with Form B, median 151
98 cases in Grade IX in school 11 with Form A, median 170.
173 cases in Grade IX in city 1 with form A, median 154.

TABLE V.—THE VARIATION AMONG INDIVIDUAL PUPILS IN FOUR SCHOOLS, EXAMINATION OF 1922, GRADE IX (IN PER CENT)

Score	School 12	School 13	School 14	School 15
40–49				
50–59				
60	.15	.5	.5	.15
70	.15	.3	1.1	.5
80	.15	.5	.5	.8
90	.7	.8	2.4	.9
100	.9	1.6	4.0	1.9
110	2.1	2.2	6.4	2.4
120	4.3	5.7	5.1	2.2
130	5.5	4.5	8.3	4.2
140	6.9	8.6	8.0	7.2
150	7.8	7.3	8.6	6.9
160	8.7	10.5	9.4	7.8
170	8.8	9.1	8.8	8.9
180	10.5	10.0	9.4	9.7
190	9.4	9.4	7.8	8.8
200	7.5	8.1	6.4	8.3
210	6.9	7.5	4.3	8.6
220	6.6	3.5	3.2	6.0
230	5.5	4.0	2.4	4.5
240	2.8	2.4	1.3	3.9
250	2.2	1.4	.3	2.2
260	.3	.6	.8	2.0
270	.....	.6	.5	.6
280	.3	.2	....	.9
290	.3	.3	....	.15
300	.....	.2	.3	
310	.15	.....	...	.15
320	.15			
330				
340				

The beneficial influence of studying a subject upon gain in the tests used could act either by increasing the abilities which they are designed to measure, or by increasing the special practice effect whereby a pupil does better in a second trial after a year irrespective of any change in his general abilities. It will be possible, though very expensive in time and labor, to extend our experiments so as to differentiate between these two effects; and we hope sometime to do so. In the

present experiment, however, we compare studies in the gross total gain, without differentiation. The special practice effect is perhaps in some ways a better indication of gain in intelligence than the gain in the examination score apart from the special practice effect. If one pupil has so changed during a year that he can utilize the experience of 1922 and the fore exercise and new test, so as to adapt himself better than another pupil, to the similar test conditions and tasks of 1923, he has shown a gain in power to learn and think in a natural and representative problem situation. On the other hand, it is true that his special practice gain may depend in part on his having utilized the experience of 1922 in 1922, as well as in 1923, better than other pupils; and so may measure his status in 1922 as well as his gain from 1922 to 1923. So differences in the special practice gain which correspond to studying a certain subject from 1922 to 1923 may measure the selective action of that study as well as its action in changing those whom it selects.

We have elsewhere shown that the B form of the examination is approximately 2½ points easier than the A form and that the average gain from May 1922 to May 1923 was, after allowance for the greater ease of B, 23 points, of which 11.9 ± 1.0 are attributable to the special practice with the examination, leaving 11.1 points as due to the growth and training of the year.

The Record of Studies.—On the cover page of the examination booklet the pupil answered the question: "What subjects are you studying this year?" It would have been better to have used the school's records directly and it would probably have been better to have asked the pupils to report each half year separately. We did not realize the extraordinary diversity of individual programs when the investigation was being planned. However, the errors made by pupils are not many and are largely, if not entirely, random with respect to the relation of studies to gains. They act to blur differences in studies in respect to gains. The same blurring or reduction comes from our errors in interpreting their reports. Our method of interpreting them was simple and rigid. We recorded each study that the pupil mentioned unless we were sure that two studies, for example history 11 and history 12 formed a one-year-course; then we recorded history 11 and 12 as one study. For a pupil to be recorded as having taken a study then usually means that he devoted one-fourth or one-fifth of his time to it for a year, but it may mean that he took it for only half the year, or for only one or two periods a week. It would have been better to

have recorded for each pupil for each study a weight representing the periods for week or points credit attached to it.

We recorded the pupils' entries by symbols according to the following scheme:

English, Business English, Debating, Public speaking, Reading, Modern drama	1
History	2
American	2I
Modern European, English, Industrial	2II
Medieval	2III
Ancient	2XX
Bible	2XXX
Biology	3
Zoology	3I
Botany	3II
Physiology	3III
Hygiene	3XX
Algebra (elementary)	4
Intermediate	4I
Advanced	4II
Geometry	5
Plane	5I
Solid	5II
Latin	6
Caesar, Cicero, Prose, etc.	6
French	7
Drawing or art	8
Freehand	8I
Mechanical	8II
Architectural	8III
Modeling	8XX
Interior decorating	8X
Painting	8_1
Commercial	8_2
Science or general science	9
Geology, Physical geography, Physiography	Ph
Spanish	Sp
German	G
Physics, Electricity	P
Chemistry, Household chemistry	Ch
Civics, Community civics	Ci
Cooking	Co
Home economics, Domestic science, Domestic art	Cs
Commercial subject	Com.
Bookkeeping, Accounting	b
Business practice, Business organization, Business law, Commercial science, Commercial geography	Bu
Arithmetic or commercial arithmetic	Ar
Agriculture, Horticulture	a
Astronomy	As
Architecture	Arc
Dramatic arts, Expression, Elocution	Da
Economics	Ec
Engineering	Eng
Greek	Gk
Journalism, Speech writing	Jo
Manual training, Drafting, Crafts	M
Military R.O.T.C.	Ml
Music, Chorus, Harmony, Orchestra, Glee club, Music appreciation	Mu
Music history	Mu
Combined subject (8, PT, Mu)	Cb
Penmanship	Pen
Psychology	Psy
Physical training, Dancing, Gymnasium	PT
Radio	R
Salesmanship	Sal
Shop, Woodwork, Machine shop, Forging, Printing, Joinery, Turning, Brick laying, Carpentry, Metal work, Gas engine, Auto repairing, etc., Pattern making	Sh
Spelling	Spl
Stenography, Shorthand, Typewriting, Transcription	St
Sewing, Costume design, Millinery, Dressmaking	Se
Sociology	Soc
Trigonometry	Tr
Teacher training, Pedagogy, Normal review	TT_1

It would have been better to have kept stenography and typewriting separate in schools where they were reported separately as we did with cooking and sewing, but this was realized too late.

It would perhaps have been better to have disregarded studies like chorus, gymnasium, music and physical training where there was strong evidence that only an hour a week was spent on the study.

In general, it would have been wiser to have saved time and money for a more careful record of studies taken by reducing the number of individuals tested. This was not fully realized until too late and would have been less satisfactory to the cooperating schools. The record of studies is the least satisfactory feature of the investigation; but it so happens that the general outcomes of the investigation are such as are not appreciably affected by its defects.

We have then for each pupil a record like that shown below.

William H. Snow, Boy, Grade XI, 16 yr. 9 mo., School 15, Identification C 2496
Studies 1 Ph p Ec

	Sel.								Gen.										
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	W	N	S	Total
Scores 1922	60	12	0	36	18	4½	18	1	8	5	2	6	36	8	26	116	110	14½	240½
Scores 1923	46	12	8	42	15	16½	16	18½	20	4	2	10	42	10	22	154½	93	36½	284
Gain																38½	−17		43½

If now we can find a sufficiently large number of pupils who took say studies 1 2_{III} 5 6 and a sufficiently large number who took studies 1 2_{III} 5 3_{II}, and if the two groups are alike in grade, age, sex, and initial ability, we can compare the gains of the 1 2_{III} 5 6 pupils with those of the 1 2_{III} 5 3_{II} pupils and measure thereby the difference made by taking 6 rather than 3_{II} as a school study, under present conditions in American cities. We may use in a similar way any other groups which are alike save in one that 3 replaces 6 as a study. As soon as any one study is found to be identical with any other in effect upon the year's gain, it can be treated as equivalent in further comparison of other studies.

This method of measuring the differences between studies upon gains in the examination score is, however, out of question for two reasons. First, the multiplicity of different programs makes a requirement of tens of thousands of hours of skilled statistical labor. Second, the small number of cases for any one comparison makes its result too unreliable. Even when all differences of subscripts are disregarded, 1023 pupils taken at random in Grade X in one city displayed 703 different programs; and 529 pupils taken at random in Grade X in another city reported 436 different programs. Our entire group would probably show over 2500 different programs if the subscript differences are counted, and over 1500 if all subscript differences are

disregarded.[1] Very few programs would be represented by as many as 50 individuals.

The mean square error of the gain for any random sampling of the group is $\frac{23}{\sqrt{n}}$, so that the mean square error of the difference between two groups of populations n_1 and n_2 is, if n_1 and n_2 are approximately the same, $\frac{1.414x}{\sqrt{\frac{n_1 + n_2}{2}}}$. If n_1 and n_2 are 25, for example, the mean square error of the difference in gain is about 6.5. Our errors may be a little less, since the variability of the gain in a group all taking the same may be a little reduced, as we shall see. However, for our purposes, the probable error needs to be less than 0.5, which corresponds to a mean square error of about .75, requiring that there be about 1600 pupils in a group!

We have therefore restricted our comparisons to 39 of the main study groups, disregarding all subscript divisions, and have made our first treatment of the problem by a different method, as follows: We arrayed each pupil's record of studies under the gain made by him, thus making an enormous table of studies correlated under gains[2] of the sort illustrated by a small sample below (Table VI). The number of occurrences of each subject in each column of Table VI is added, giving the facts of Table VII (shown only in part).

The entries of Table VII read as follows: Among individuals gaining −31 or less in Schools 4–11, English (1) was taken 11 times; history (2) was taken 10 times; biological studies (3) were taken 0 times; and so on. If a pupil took two courses in the same subject, it was counted twice.

Each entry of the table sampled by Table VII was then turned into a percentage of the sum of its column, that is, of the total number of courses reported by pupils in that city making that amount of gain.

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[1] Diversity of High School Students' Programs. *Teachers College Record*, Vol. XXIV, pp. 111–121.

[2] The uncorrected gains were used here since the whole table was only for provisional use, and the only harm done is to assign all the studies of Schools 21, 22, 23, 24, and 25 to gains 2½ lower than should be the case, and all the studies of cities 1 and 4 to 15 to gains 2½ higher than should be the case. The facts for Schools 21, 22, 23, 24 and 25 were kept separate and could have been shifted over to equivalence with those of cities 1 and 4 to 11, but the differences between gains were all so slight that this did not seem necessary.

As a result, we have a table of which Table VIII shows a part. The percentages were then rearranged to make Table IX (shown in part only).

TABLE VI.—THE RELATION OF STUDIES TO GAINS INVENTORY
School 4–11

−31 or less	−26 to −30	−21 to −25	−16 to −20
1 2 5 a	1 2 4 Ph	1 Ci Cs	9 Sp St St
2 1 4 8 PT	2 8 Sp p	9 St St	1 4 St St
1 2 5 Co Se	1 7 St Ci	1 9 Cs	1 3 8 Ci
1 2 5 7	1 5 Co Se	1 2 5 7 Ch	1 4 7 St St
1 2 7 Ci St	1 8 Ch Ci	1 7 Sp	1 St Bu Bu
1 2 p Ec	1 5 8 St b	1 3 5 6 St	1 Sp Bu Bu
2 4 Sp St	1 3 8 Ci Tr Se	1 3 4 6	1 5 Bu Bu
Etc.	Etc.	Etc.	Etc.
Schools 12–15			
1 2 6 Se Mu	1 2 3 Co Mu	1 2 3 6 Se	1 2 7 Se b
1 2 3 Se b	1 6 8 Ch	1 Ar Se PT B	1 3 4 Sh Sh
1 2 5 8 Sh	Bu Ci St Cs Jo	1 3 Co Se Ar Bu	1 2 4 8
1 2 Bu Sh Se	2 Da St St Bu	1 5 Ar b Ml	1 2 Bu Bu Ml
1 2 3 7 Se	2 4 8 Ch	1 2 3 3	1 1 3 6 8
1 3 7 Da Co	1 2 3 5 Mu PT	1 2 3 6 Pt	1 2 Da b
1 8 B PT St	1 2 3 Ml PT Sh	1 4 P Tr Ec Soc Bu	1 2 4 6 Da Mu
Etc.	Etc.		
Schools 21–25			
1 2 6 M PT	1 5 6 PT	1 6 Sp Co PT St	1 5 9 Sh
1 2 7 Ci St St b	1 2 Cs b	1 2 5 b	1 5 9 Sh
1 3 7 Sp Ci Psy	1 5 8 Ch Tr Psy	1 1 2 5 St Sh	1 2 4 5 6 8 PT
Etc.	Etc.	Etc.	Etc.

TABLE VII.—THE RELATION OF STUDIES TO GAINS, FREQUENCIES

Study	Individuals gaining −31 or less Frequency in schools			Individuals gaining −26 to −30 Frequency in schools			Individuals gaining −21 to −25 Frequency in schools		
	4–11	12–15	21–25	4–11	12–15	21–25	4–11	12–15	21–25
1	11	23	35	6	13	24	16	42	44
2	10	20	23	1	14	13	4	33	21
3	..	14	6	1	5	7	4	19	10
4	4	1	12	1	1	5	3	3	7
5	5	8	11	2	5	12	3	9	20
6	..	1	6	..	2	8	5	13	9
7	3	4	5	1	2	2	4	5	5
8	3	9	6	3	6	6	..	12	12
9	1	...	3	..	...	3	2	...	8
a	1								
Ar	1	1	...	..	...	...	1	4	2
b	1	11	5	1	1	2	2	7	6
Bu	..	3	3	..	2	3	6	3	3
Cb									
Ch	1	3	6	1	3	5	2	2	6
Ci	5	1	19	3	...	8	6	...	14
Co	1	2	1	1	1	1	2	4	2
Cs	1	1	1	..	1	...	2	...	2
Da	..	2	1	..	1	...	1	4	2
Ec	1	1	3	..	...	...	2	1	3
G									
Jo	..	1	1	..	1	...	..	2	
M	..	1	4	..	1	1	1	1	1
Ml	..	1	...	..	4	...	..	2	
Mu	..	2	6	1	3	2	1	4	11
p	2	...	7	..	1	2	1	3	4
Ph	1	1	4	1	2	3	..	5	
Psy	..	1	4	..	...	4	..	1	
PT	1	7	4	1	3	2	..	18	5
Se	1	9	6	2	3	2	3	10	3
Sh	..	10	8	..	2	5	2	9	7
Soc	..	5	..	..	...	...	..	1	
Sp	2	5	16	..	2	14	1	4	20
Spl									
st	3	13	21	2	8	5	10	14	25
tr	1	...	3	1	1	2	1	2	3
TT	..	...	...	..	1	...	1		
									1 (pen)
Total...	60	161	230	29	90	141	86	237	256

TABLE VIII.—THE RELATION OF STUDIES TO GAINS, FREQUENCIES IN PER CENT

Study	Individuals gaining −31 or less Relative frequency (in per cent) in schools			Individuals gaining −26 to −30 Relative frequency (in per cent) in schools			Individuals gaining −21 to −25 Relative frequency (in per cent in schools		
	4–11	12–15	21–25	4–11	12–15	21–25	4–11	12–15	21–25
1	18.3	14.3	15.2	20.7	14.4	17.0	18.6	17.7	17.2
2	16.7	12.4	10.0	3.4	15.6	9.2	4.7	13.9	8.2
3	....	8.7	2.6	3.4	5.6	5.0	4.7	8.0	3.9
4	6.7	.6	5.2	3.4	1.1	3.5	3.5	1.3	2.7
5	8.3	5.0	4.8	6.9	5.6	8.5	3.5	3.8	7.8
6	....	.6	2.6	....	2.2	5.7	5.8	5.5	3.5
7	5.0	2.5	2.2	3.4	2.2	1.4	4.7	2.1	2.0
8	5.0	5.6	2.6	10.3	6.6	4.3	....	5.1	4.7
9	1.7	....	1.3	....	....	2.1	2.3	....	3.1
a	1.7								
Ar	1.7	.6	....	....	....	....	1.2	1.7	.8
b	1.7	6.8	2.2	3.4	1.1	1.4	2.3	3.0	2.3
Bu	....	1.9	1.3	....	2.2	2.1	7.0	1.3	1.2
Cb					1.1				
Ch	1.7	1.9	2.6	3.4	3.3	3.5	2.3	0.8	2.3
Ci	8.3	.6	8.3	10.3	....	5.7	7.0	....	5.5
Co	1.7	1.2	.4	3.4	1.1	.7	2.3	1.7	.8
Cs	1.7	.6	.4	....	1.1	....	2.3	....	.8
Da	....	1.2	.4	....	1.1	....	1.2	1.7	.8
Ec	1.7	.6	1.3	....	....	....	2.3	.4	1.2
g									
Jo	....	.6	.4	....	1.1	....	....	.8	
M	....	.6	1.7	....	1.1	.7	1.2	.4	.4
Ml	....	.6	....	....	4.4	....	....	.8	
Mu	....	1.2	2.6	3.4	3.3	1.4	1.2	1.7	4.3
p	3.3	....	3.0	....	1.1	1.4	1.2	1.3	1.6
Ph	1.7	.6	1.7	3.4	2.2	2.1	....	2.1	
Psy	....	.6	1.7	....	....	2.8	....	.4	
PT	1.7	4.3	1.7	3.4	3.3	1.4	...	7.6	2.0
Se	1.7	5.6	2.6	6.9	3.3	1.4	3.5	4.2	1.2
Sh	....	6.2	3.5	....	2.2	3.5	2.3	3.8	2.7
Soc	....	3.1	....	....	....	....	....	.4	
Sp	3.3	3.1	7.0	....	2.2	9.9	1.2	1.7	7.8
Spl									
St	5.0	8.1	9.1	6.9	8.8	3.5	11.6	5.9	9.8
Tr	1.7	....	1.3	3.4	1.1	1.4	1.2	.8	1.2
TT	....	....	....	....	1.1	....	1.2		
									.4 (pen)

TABLE IX.—THE RELATION OF STUDIES TO GAINS: FREQUENCIES IN PER CENTS FOR PUPILS OF EACH AMOUNT OF GAIN

Study	Schools	Gains													
		−31 or less	−26 −30	−21 −25	−16 −20	−11 −15	− 6 −10	−1 −6	0 +4	+5 +9	+10 +14	+15 +19	+20 +24	+2	+80 or over
1. English.....	4–11	18.3	20.7	18.0	21.4	23.5	23.8	20.0	23.4	20.6	20.8	21.8	19.8	....	22.6
	12–15	14.3	14.4	17.7	17.9	16.9	17.4	18.3	17.6	18.1	17.3	17.6	16.9	....	16.3
	21–25	15.2	17.0	17.2	16.6	16.6	16.3	16.6	17.2	16.4	17.0	17.1	16.8	....	14.2
2. History.....	4–11	16.7	3.4	4.7	8.3	11.8	10.0	9.0	11.4	10.0	11.3	9.2	12.3	....	12.0
	12–15	12.4	15.6	13.9	14.1	13.2	14.3	11.0	13.2	12.1	12.9	12.4	12.2	....	8.9
	21–25	10.0	9.2	8.2	10.4	11.8	9.2	12.9	9.6	11.4	11.2	10.5	11.8	....	10.0
3. Biological sciences.	4–11	0.0	3.4	4.7	4.8	5.8	4.8	4.3	5.1	2.6	3.6	7.4	3.2	....	2.3
	12–15	8.7	5.6	8.0	7.2	6.8	7.3	5.2	4.5	5.5	4.6	5.5	5.4	....	2.5
	21–25	2.6	5.0	3.9	3.1	3.6	4.2	4.2	4.1	3.5	4.2	3.1	3.6	....	5.8

Each percentage for English was then expressed as a ratio of the median of the 24 percentages for English for the group of schools in question; and the same was done for every other study. The result is a table like Table X (shown in part only).

The results for the three systems of schools were then combined for each study by taking the median of the three ratios at −31 or lower, the median of the six at −21 to −25 and −26 to −30, the median of the six at −11 to −15 and −16 to −20, and so on, ending by taking the median of the three ratios at +80 or over. This gives us 14 values for each study. These are listed in Table XI for all the studies which have any considerable number of enrollments.

From Table XI, or more clearly from Table XII, we see that there is a positive relation between the presence of French or Chemistry in a pupil's program and gain in the test, and a negative relation between the presence of cooking and sewing in a pupil's program and gain in the test. In the case of shop, Spanish, or drawing, there is zero relation approximately, these studies being as frequent in the programs of pupils who gain little as in those who gain much.

Table XII gives the equations of the straight lines which are the best fits for the values of Table XI.[1] In these equations the unit for y

[1] The equations of Table X are derived by treating the cases at −31 or less as centered at −35, the cases at +80 or over as centered at +85; and the values at −35, −25, −15, −5, +5, etc. are given equal weight. Neither of these procedures is correct, but the errors introduced are small.

is one-hundredth, the unit for x is one score point of gain. That is, $y = .48x + k$ for French, means that for every rise of 1 point in gain, there is an increase of $.48 \times .01$ in the ratio of the frequency of entries of French to the median frequency of entries of French. For example, the ratio would rise from say .76 for gainers of -25, to 124 for gainers of $+75$.

To discover what a rise in relative frequency from, say, .76 for gainers of -25 to 1.24 for gainers of 75 means in terms of superiority to the average study in gain, we must compute what the effect of any given superiority in gain due to a study will be upon the rise in relative frequency as we pass from low gainers to high gainers.

It can be shown that if the number of entries in our Table VI for any one study is small in comparison with the total number of entries, (as it always is expected in the case of English, which is neither inferior nor superior) a superiority of gain.

½ score point corresponds to a slope of $y = k + .09\frac{1}{2}x$, the units being as in Table X.

1 score point corresponds to a slope of $y = k + .19x$, the units being as in Table X.

2 score points correspond to a slope of $y = k + .38x$, the units being as in Table X.

3 score points correspond to a slope of $y = k + .57x$, the units being as in Table X.

4 score points correspond to a slope of $y = k + .76x$, the units being as in Table X.

5 score points correspond to a slope of $y = k + .95x$, the units being as in Table X.

A slope of $y = k + .01x$ corresponds to a superiority in gain of .0526 score points.

A slope of $y = k + .02x$ corresponds to a superiority in gain of .1053 score points

A slope of $y = k + .03x$ corresponds to a superiority in gain of .1579 score points.

A slope of $y = k + .04x$ corresponds to a superiority in gain of .2105 score points.

A slope of $y = k + .05x$ corresponds to a superiority in gain of .2632 score points.

etc.

The superiorities of French, chemistry, and trigonometry, as shown by Table XI and Table XII, are then such as would be pro-

duced if taking French, chemistry, and trigonometry increased a pupil's gain by 2.5, 2.4, and 2.3 score points respectively over what it would be if he had taken an average mixture of studies in place of the French or chemistry or trigonometry. The inferiority of dramatic art or stenography shown by Table IX and Table X are such as would be produced if taking one of these studies instead of an average mixture of studies reduced a pupil's gain by $-2.0\frac{1}{2}$ or $-2.1\ \frac{1}{2}$ score points respectively.

TABLE X.—PER CENT OF EACH LINE OF THE RELATION OF STUDIES TO GAINS. THE FACTS OF TABLE VII EXPRESSED AS RATIOS OF THE MEDIAN PER CENT FOR THAT LINE

Study	Schools	Gains													
		−31 or less	−26 −30	−21 −25	−16 −20	−11 −15	−6 −10	−1 −6	0 4	5 9	10 14	15 19	20 24		80 or over
1. English.....	4–11	.87	.99	.86	1.02	1.12	1.14	.96	1.12	.98	.99	1.04	.95	....	1.08
	12–15	.82	.82	1.01	1.02	.97	.99	1.04	1.00	1.03	.99	1.00	.97	....	.93
	21–25	.92	1.03	1.04	1.01	1.01	.99	1.01	1.04	.99	1.03	.04	1.02	....	.86
2. History.....	4–11	1.46	.30	.41	.73	1.03	.88	.79	1.00	.87	.99	.80	1.08	....	1.06
	12–15	1.00	1.26	1.12	1.14	1.06	1.15	.89	1.06	.98	1.04	1.00	.93	....	.70
	21–25	1.00	.92	.82	1.04	1.18	.92	1.29	1.86	1.14	1.12	1.05	1.00	....	1.00
3. Biological sciences.	4–11	0.00	.81	1.11	1.13	1.39	1.13	1.03	1.22	3.00	.85	1.77	.76	....	.54
	12–15	1.71	1.09	1.57	1.42	1.34	1.43	1.02	.88	1.07	.91	1.09	1.05	....	.48
	21–25	.72	1.38	1.08	.85	.98	1.15	1.16	1.14	.98	1.15	.85	.99	....	1.61

TABLE XI.—THE RELATION OF STUDIES TO GAINS: SUMMARY OF TABLE VIII ALL SCHOOLS COMBINED

	Study	Gains												
		−31 or less	−21–30	−11–20	−1–10	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80
1	English	.87	1 00	1.015	1.00	1.015	1.015	1.015	1.025	.97	.97	.99	.97	.93
2	History	1.00	.87	1.05	.905	1.03	1.02	1.04	.945	.98	1.025	.97	1.16	1.00
3	Biology	.72	1.10	1.235	1.14	1.105	1.00	1.00	1.115	.96	.78	.78	.96	.54
4	Algebra	1.38	.83	1.07	.985	.895	.965	1.00	.935	1.11	.955	1.38	1.20	1.18
5	Geometry	.86	1.005	.98	.86	.935	.955	1.065	1.015	1.045	1.07	1.20	.90	1.04
6	Latin	.12	.95	.935	.885	.96	1.02	.975	1.115	1.055	1.19	1.23	.98	.66
7	French	.93	.785	.72	.815	1.04	1.075	.855	1.03	.96	1.095	1.14	1.525	1.38
8	Drawing	1.22	1.095	.845	.885	1.00	1.005	1.00	.92	1.025	.895	1.265	.575	1.34
9	General science	.63	.51	.755	.705	1.57	.95	1.21	1.135	.765	1.105	1.04	1.185	1.04
Ar	Arithmetic	.67	.54	.785	.91	1.09	1.08	.965	1.00	1.055	1.07	.71	.495	1.11
b	Bookkeeping	.91	.905	.820	1.035	1.155	1.035	1.02	1.12	1.07	.885	.885	1.375	1.31
Bu	Business	.69	1.005	1.055	1.25	1.03	1.165	1.26	.94	1.035	.935	.62	.965	.99
Ch	Chemistry	.84	.995	.885	.615	.625	.95	.965	1.10	1.21	1.365	1.305	.98	1.37
Ci	Civics	1.50	1.01	.805	1.18	1.00	.975	1.015	.95	1.10	1.015	.720	.815	1.05
Co	Cooking	.96	1.20	1.125	.825	1.175	1.34	.96	1.125	.88	1.05	.69	.73	0.00
	Cooking and sewing	2.19	.84	1.21	2.18	1.19	.995	1.165	.395	1.315	.615	1.225	0.00	0.00
Da	Dramatics	.56	.65	.755	1.36	1.18	1.16	1.17	1.505	1.29	1.04	.725	0.00	0.00
Ec	Economics	2.11	.245	.780	.835	.960	1.165	1.33	.58	1.035	. 88	1.075	0.79	0.00
	Journalism	1.63	1.09	.51	1.08	.755	.735	1.095	1.36	1.195	1.87	.593	0.00	1.765
M	Manual training	2.155	1.065	.765	.505	1.435	1.115	1.02	.685	1.265	1.21	1.04	.46	.50
Ml	Military training	.17	.235	.885	1.15	1.27	.985	.695	.880	1.20	1.17	1.29	.405	.965
Mu	Music	.54	1.12	.755	1.06	1.005	1.005	1.145	1.20	1.015	.74	.925	.670	1.05
PT	Physical training	.85	.675	1.115	.98	1.005	1.03	.985	.89	1.04	1.02	.80	.94	1.47
P	Physics	1.14	.645	.565	.885	.875	.87	.89	.815	1.20	1.155	1.35	1.205	1.09
Ph	Geology, Physiography, Physical geography	1.485	1.695	1.29	1.18	1.08	1.015	.875	1.15	.825	.73	1.515	.35	.97
Psy	Psychology	1.145	.340	.995	1.00	1.085	1.050	1.115	1.14	.925	.885	.82	.365	.32
Se	Sewing	1.52	1.125	1.00	1.30	.98	1.13	.925	1.075	1.00	.96	.70	1.01	0.00
Sh	Shop	1.26	1.10	.895	1.065	.905	.925	1.025	.95	1.015	1.055	1.17	1.31	1.11
Soc	Sociology	1.32	0.00	1.51	1.22	.915	1.165	.925	.59	1.225	1.300	1.05	1.175	.205
Sp	Spanish	1.11	.485	.995	1.135	.92	.925	1.085	1.04	.99	1.065	.975	.89	.79
St	Stenography	1.16	1.12	1.245	1.27	1.105	.99	1.00	1.01	.955	.915	.76	.66	.85
TT	Teacher training	0.0	0.0	1.31	.93	1.655	1.205	1.14	1.49	1.195	1.675	0.00	0.00	0.00
Tr	Trigonometry	1.34	1.415	.34	.395	.695	.93	.98	.985	1.225	1.18	1.085	1.205	1.78

TABLE XII.—THE RELATION OF STUDIES TO GAINS MEASURED BY THE RELATIVE FREQUENCY OF THE STUDY IN GROUPS MAKING VARIOUS AMOUNTS OF GAIN

N being large	Equivalent superiority or inferiority in gain in score points	*N* being small	Equivalent in score points	*N* being too small to permit any estimate
French + 0.48*x* + *K*	2.5			Agriculture
Chemistry + 0.46*x* + *K*	2.4			German
Trigonometry + 0.44*x* + *K*	2.3			Greek
Physics + 0.39*x* + *K*	2.0½	Military training + 0.39*x* + *K*	+2.0	Penmanship
General science + 0.37*x* + *K*	1.9½			Radio
Latin + 0.32*x* + *K*	1.7			Spelling
Bookkeeping 0.25*x* + *K*	1.3			
Physical training + 0.21*x* + *K*	1.1			
Arithmetic + 0.13*x* + *K*	0.7			
Geometry + 0.13*x* + *K*	0.7			
Algebra + 0.12*x* + *K*	0.6½			
History + 0.07*x* + *K*	0.4			
Music + 0.04*x* + *K*	0.2			
Shop + 0.03*x* + *K*	0.1½			
Spanish + 0.00*x* + *K*	0.0	Journalism − 0.02*x* + *K*	−0.1	
English − 0.00*x* + *K*	0.0			
Drawing − 0.01*x* + *K*	−0.0½			
Business − 0.07*x* + *K*	−0.4	Sociology − 0.13*x* + *K*	−0.7	
Civics + 0.24*x* + *K*	−1.2½	Teacher training − 0.21*x* + *K*	−1.1	
Biology − 0.27*x* + *K*	−1.4	Psychology − 0.34*x* + *K*	−1.8	
Dramatic art − 0.39*x* + *K*	−2.0½			
Stenography − 0.41*x* + *K*	−2.1½			
Economics − 0.50*x* + *K*	−2.6+			
Cooking − 0.55*x* + *K*	−2.9	Manual training − 0.58*x* + *K*	−3.0½	
Sewing − 0.66*x* + *K*	−3.5	Physiography − 0.58*x* + *K*	−3.0½	
Cooking and sewing − 1.23*x* + *K*	−6.5			

CURRICULUM-MAKING:

WHAT SHALL CONSTITUTE THE PROCEDURE OF NATIONAL COMMITTEES?

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American education can advance no more rapidly than the rate at which its basic facts and laws are discovered. Within the field of the curriculum two concurrent publications exhibit clearly the chief methods by which school men are attempting to discover these basic facts and laws. These publications are: (1) Thorndike and others, *The Psychology of Algebra*;[1] (2) *The Reorganization of Mathematics in Secondary Education*[2] (Mathematical Association of America), prepared by a committee of mathematics teachers.

Students of curriculum-making as well as teachers of mathematics should study these two reports together. They supply notable additions to our knowledge of the content and teaching of secondary mathematics. But better than that, for the purposes of our discussion, they set out in clear relief two sharply contrasted methods of improving the materials of instruction in American schools—the method of committee procedure and the method of laboratory analysis. These two methods are in reality complementary. Neither should be ignored. One, the fundamental one, is being ignored to such an extent that the situation should be commented upon somewhat fully.

The Reorganization of Mathematics in Secondary Education is the report of 13 teachers of mathematics, working as the National Committee of Mathematical Requirements. *The Psychology of Algebra* on the other hand, is the report of the investigations of Dr. Thorndike and five co-workers in the Institute of Educational Research of Teachers College. Thus we have at hand for study, excellent examples of two methods of work: the method of expert teaching opinion and the method of expert analysis of social and psychological needs. One is primarily subjective, the other much more objective. Particular phases of the total problem can be most effectively attacked by the former; without the latter, however, no lasting progress in curriculum making can be made.

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[1] Macmillan Company, New York City.

[2] Distributed by Professor J. W. Young, Hanover, N. H.

It is fortunate for our discussion that these reports are good examples of the two methods under consideration. There is no question that they are. Critical study of committee procedure leads to the conclusion that the report of the National Committee is far superior to any report hitherto produced in any school "subject" by such methods. Its methods too, were much more systematic and thorough than those of earlier committees.

Yet in spite of the thoroughness and intelligence with which the work of the committee was carried out its report shows the inadequacy of methods of committee procedure which are not based primarily on objective analysis. It is chiefly with a review of the methods employed that we are concerned.

Two preliminary comments should be made to orient the reader of this article. First: The purpose of this paper is not to present a detailed review of all that the two groups did. That is impossible in the space at hand. The reports are used here merely because they supply clear illustrations of the techniques that should be employed by National Committees. Second: It is especially important to keep that point in mind because of the difference in the scope of the curriculum covered by the two reports. The studies of Professor Thorndike and his group are centered upon algebra in Grade IX; those of the National Committee deal with the entire range of secondary mathematics. There is no intent to make comparisons which are based upon this difference in the scope of the curriculum with which each group dealt.

Two Types of Expert Service are Needed by National Committees

There is one significant characteristic about this latest enterprise in curriculum-making in mathematics: the committee was adequately financed. This is probably the most important fact before us today; that for the first time in the history of education funds are available for the study and improvement of school processes. It appears, therefore, that the National Committee had an unusual opportunity. It could employ expert service.

Two types of expert service were needed. In the order in which they could be utilized they were (1) that of specialists in curriculum-making, that is specialists trained in the study of intelligence and pupils' interests, in the study of social needs, and in the analysis of learning. (2) That of teachers of mathematics in colleges and secondary schools who were trained in the authentication of mathematical subject-matter, and were sensitive to the temper of teachers and the

needs of the classrooms. The first group of specialists is needed to discover the fundamental facts and laws of intelligence, social needs, and learning. The second group is needed to organize the facts and laws into a working program of classroom instruction. The tasks required of each group demand specialized interests, training and experience. Neither group, as educational workers are now constituted, is fitted to do the work of the other. Both are necessary for the proper reorganization of mathematics; *both are indispensable in the proper reorganization of any department of school work.*

The National Committee Employed Only One Kind of Expert Service

The National Committee, having large funds at its command employed the second type of service. It did not employ specialists in curriculum-making. Part of its money was wisely used to secure the full-time services of two outstanding leaders in college and secondary mathematics—Professor J. W. Young of Dartmouth and Mr. J. A. Foberg of the Pennsylvania State Department of Public Instruction. These two men maintained efficient offices for two years and set up machinery by which they were able to coordinate the efforts of fully one hundred sectional organizations of teachers. They travelled much and widely. They "felt the pulse" of mathematics classrooms all over the country. They studied the literature of "the reorganization of mathematics" carefully. For the first time in the history of committees the analysis of school practice was oriented about the current dynamic and inductive point of view in educational psychology. Their report reflects the distinctive success with which they were able to make themselves familiar with current thought in psychology. They gave unsparingly of their unusual energy and intelligence in the attempt to sound the temper of teachers and to evaluate the proposals of innovators. They organized the results of this inventory of *what the country can be brought to do* in a program of grade and classroom instruction that advances very much the organization and teaching of mathematics. So well did they do what they regarded as their sole function that this is certainly a *conspicuous* committee report. *In no subject has so complete, so forward-looking a report come from the work of a national committee.* It is a clear-cut statement of the extent to which teachers of mathematics can be expected to put into practice a reorganized mathematical instruction.

We must not forget, however, that whereas two types of expert service were needed only one was employed—the traditional one—that of teachers trained and experienced in subject-matter. This is typical of current practices in curriculum-making in American schools. To the present time school courses of study have been made either by specialists in the authentication and documentation of subject-matter or by secondary school teachers who were trained by such people and who are dominated by their points of view. These latter ones have frequently complained of late that "educationists" have interjected themselves into the work of making the course of study. "Why," one hears it asked, "should a person be permitted to reorganize the elementary and secondary mathematics curriculum when he is not primarily a mathematician? How can a person who is not a "geographer" construct a curriculum in geography, or how can people who have never published the results of historical research contribute to the school curriculum in history? "Why don't these pedagogues attend to their own jobs and leave our field alone," is the burden of the plaint.

The direct and significant reply is—that it is the specialists in subject-matter (at least those who have not entered definitely upon the study of experimental education) who are out of their territory when they attempt to do the fundamental work underlying the making of curricula—not the students of the science of education. Curriculum-making is rapidly becoming a specialized and technical field of work, success in which requires scientific knowledge of society and how to study it, a grasp of the facts and laws of human behavior and definite training and experience in the use of the scientific tools of education—namely, objective analysis, measurement, statistical methods, and the technique of experimentation. The fact is that we are witnessing the development of a new body of specialists who are devoting their energies to building up a scientific approach to the curriculum. Already the work of this group is influencing fundamentally certain phases of elementary school instruction. (For example, what book company will now publish a spelling book without checking its content against the results of the most authoritative scientific studies of adult writing vocabularies?)

Is it not clear that the task of curriculum-making is a specialized technical task to be carried on most effectively by a cooperating body of curriculum specialists? Should not these be trained, on the one hand, in the study of social needs, in the analysis of the abilities and

interests of growing children and in the experimental study of learning and, on the other hand, in testing the temper of school teachers and administrators—that is of finding out what the country will do? The second task amounts to getting school officials to put into operation a curriculum based as nearly as possible on the findings of objective investigation. Since this would mean in most instances a very radical departure from the current order and since the curriculum-fitters are themselves a vital part of the current order the difficulties of the task will be clear at the outset.

The Major Questions Confronting Those Who Propose Reorganizations of the Curriculum

Let us apply our criterion of curriculum-making to the two reports under consideration. What are the major questions to which curriculum makers—either committees or individuals—must find the answers? Are they not these?

First: What are the abilities and the interests of the pupils?

Second: What materials (mathematical in this instance) do they need to study, both as growing youth in school and as prospective citizens in a highly industrialized society?

Third: In what school grades shall these materials be utilized and in what order and arrangement within these grades?

Apparently simple and direct questions are they not? In reality, there are no more puzzling questions in education today than these. For a decade scores of investigators have racked their brains to find even tentative solutions. As a result a varied literature of objective analysis is growing up. To illustrate: the general mental abilities of pupils of various ages have been studied by objective methods; a host of statistical studies now supply fairly definite evidence concerning the elimination and retardation of pupils in our schools; there has been much discussion, although little measurement, of children's interests and the dynamics of teaching.

It appears therefore that the background and illustrative techniques have been provided for the systematic and scientific study of the curriculum, mathematics included.

The two books before us make it possible to measure the extent to which these techniques are used in the reorganization of instruction in American secondary schools. The three major questions merely present the gross need. Their itemization will enable us to evaluate the two principal current methods of reorganization.

Objective Studies Are Needed to Supply Facts about the Pupils—Their Intelligence, Their Interests, Their Future Occupations and the Like

Whether he investigates it first or not, eventually the curriculum-maker must consider the abilities and interests of the pupils. Are there data available with which to answer questions about them? There are—very good data indeed. Did the National Committee and the Thorndike group make use of them or supply others? Professor Thorndike used some of them and has presented new facts. In its report, however, the National Committee considers the question only in a very limited and indirect way. That its recommendations were based on a detailed consideration of the facts developed in earlier studies of the psychology of childhood and adolescence is very doubtful.

Let us be more specific. The Thorndike report presents eight new objective studies which deal directly with the pupils who study mathematics: (1) changes in the quality of the pupils entering high school; (2) the occupations of high school graduates and non-graduates; (3) the intelligence of high school pupils, including (*a*) a consideration of continuance in high school in relation to intelligence, (*b*) success in course in algebra in relation to intelligence; (4) the interest of pupils in algebra in comparison with other school subjects; (5) the interest of pupils in various features of algebraic learning; (6) individual and sex differences in algebraic ability and in interest in algebra; (7) the correlation between ability in algebra and general intellectual ability; (8) and the follow-up of that study in the analysis of special disability in algebra.

The difference in the method of the two groups—the subject matter specialists and committees of teachers on the one hand, and the students of the scientific study of the curriculum on the other—is well illustrated by the manner in which they use these data concerning the pupils. The student of education feels that he must collate and study the known facts concerning the pupils who are to study the curriculum: how old they are, what their general and special abilities are, what interests teachers will have to combat or can make use of; what proportion of the pupils probably can deal successfully with the processes of the curriculum as predicted from the success of those who study the present ones, what changes will probably come about soon in the composition of the pupils and their abilities, what will probably be the future work of various groups of the student body and hence what probably should be the constitution of their curriculum.

These questions are definitely discussed by the Thorndike group. Data are tabulated upon which the answers to the questions rest and an elaborate interpretation of them is supplied. The National Committee's report, however, treats only two studies that bear on them and these incompletely and indirectly. The first was a study of the mathematical interests of high school pupils in which data on the following questions were collected from 6978 pupils: Do pupils like or dislike mathematics? Why? What topics are liked, what topics disliked? Which high school subjects are preferred by pupils? The second study reported the facts collected by questionnaire by Dr. A. R. Crathorne from about 2000 college freshmen as to whether they had then made a decision concerning what their lifework would be and as to whether that decision had changed since they entered high school. The committee also collected and republished several questionnaire studies of the opinions of lay citizens as to the value of high school mathematics.

The first point at issue then is this: the proper reorganization of the curriculum rests upon the detailed study of the facts of the pupil body. If these are not at hand then the curriculum-maker should collect, organize, and interpret them, showing how they affect the materials of instruction. The professional student of the curriculum recognizes the value of the data and digs out of them facts that throw light upon his problems. Committees on the contrary tend to ignore them. There is no reason inherent in committee procedure that makes this course necessary except possibly the fact that committee personnel has never yet included the professional student of the curriculum.

Objective Studies Are Needed That Deal with the Content of the Curriculum

The second major field for investigation by the curriculum-maker is the determination of what to teach. The National Committee, although it did not present convincing reasons, does definitely recommend the topics to be taught in the mathematics courses of a l grades from seven to twelve inclusive and prescribes certain courses to be required of all pupils in Grades VII, VIII, and IX. This is a courageous thing to do. Committees from the Committee of Ten down to date have done it. They regard that as their primary function. Yet it is safe to say that professional students of the curriculum woud not undertake it in any high school subject. Why? The data upon which

to make the recommendation are not at hand. The professional curriculum-maker insists that his first task is to discover social and psychological needs. It is certainly not his first function to recommend the topics for courses and the number of years the courses will require. The more he studies society and children the more hesitant he becomes to recommend the details of the curriculum.

To say that all boys and girls in a great nation should use valuable time in the mastery of the twenty odd processes and operations of elementary algebra, for example, one would wish to be fairly sure either that they would be called upon to use the skill rather frequently or that the learning of it was necessary to enter into some mode of living, to grasp and use fundamental generalizations or to appreciate and understand some contemporary problem. Can the curriculum-maker be sure that all or most pupils will actually use the operations of elementary algebra unless he has determined the use that human beings do make of them? Is it not the curriculum-maker's obligation to base his recommendations on the facts of human needs? If the facts have not been canvassed is not the curriculum-maker obligated to canvass them? Several inventories of the social uses of mathematics have already been made. These inventories have reported the use of algebra in other high school studies, the social uses of geometry, the algebraic operations used by workers in industry and in preparation for semi-professional positions in industry.

At this phase of their studies, as they did when dealing with the facts of the student body, the Thorndike group made investigations of the uses of algebra. They too make recommendations concerning the topics of algebra that they believe can be defended in a required curriculum. There is a significant difference, however, between their procedure and that of the Committee: they collected certain facts of the uses of algebra first and based their recommendations upon those facts. It would have been my personal inclination to have secured more facts than they did. The chief point at issue, however, is well illustrated by what they did as contrasted with what the Committee did. Recommendations concerning what to teach must be based on the facts of human needs, social and psychological. Is not the primary task that of finding the facts and interpreting them? Unless National Committees can be persuaded that that is their first duty, will it not be difficult to justify their existence in American education?

On the topic of the "uses of algebra" the report presents studies of: (1) the uses of algebra in other high school subjects; (2) the uses of alge-

bra and geometry shown by an inventory of the Encyclopedia Brittanica; and (3) the uses of algebraic abilities as a preparation for work in the sciences in colleges and professional schools. The last study makes use of the data collected and reported by the National Committee itself. Mr. Thorndike extends the data, however, and makes a very much more complete treatment and interpretation of the data than does the committee itself. In this study the National Committee collected the judgments of a very small body of college teachers of the physical sciences and of the social sciences as to which operations of algebra, demonstrative geometry, trigonometry and analytic geometry were (*a*) essential, (*b*) of considerable value, (*c*) of some value and (*d*) of no value in the study of their subjects in college. Students of the curriculum will appreciate the work of the Committee in collecting these data.

Let us not forget, however, that they relate to the curriculum of that very small body of students who continue in school through college courses. These judgments help very little in settling the question of what to teach pupils in the junior high school. One does find reference in the Committee's report to the earlier investigations which helps in this matter. Nevertheless there can be little doubt that the members of the committee made themselves familiar with the contributions of various students of the curriculum in arithmetic and mathematics. In their forward-looking recommendations that all complicated mathematical operations be eliminated one sees the extent to which the Committee cut itself loose from adherence to many of the hoary traditions of mathematics.

There were many unanswered questions as to the uses of particular processes of mathematics, some of which could have been answered if the Committee had set up an objective analysis of social needs. This, in spite of its very large financial endowment, it did not do. Students of the curriculum will regret this greatly. I for one cannot bring myself to agree that it is a better use of funds to pay the expenses of college and high school teachers of mathematics to discuss in prolonged conferences the written reports of individual members than it is to endow objective studies of social and psychological needs. The round-table meetings do good and if funds are at hand for both these and the objective studies let us do both. In fact, once the fundamental studies are made extended conference discussion of them is preeminently worth financing. But without the facts upon which the discussion is based how far can it proceed effectively? It can proceed only to the point

of laying down the fundamental philosophy of curriculum-making in a democracy and the blocking out of a definite program of investigation, experimentation and debate. Once that is accomplished the role of investigation begins. Round-table conference must be fallen back upon periodically, of course, to check up the direction in which objective investigtion is moving, the technique employed and the conclusions drawn en route. But it is to the collection of facts about society to which as yet, we have not sufficiently addressed ourselves.

It is all the more necessary that these objective analyses of society be made because of the halo that has grown up around the conventional courses. The committee report itself—in spite of the fact that it was made by two "liberals"—exhibits frequently the reverence in which teachers hold the subject-matter that they teach. In sharp contrast to it is Professor Thorndike's much more objective analysis of the uses of algebra, the nature of the fundamental algebraic abilities, favorable and unfavorable modes of developing them and the amount of practice needed to learn particular operations.

The comment that there are many unsolved problems concerning the uses of mathematics reminds us that the Thorndike study itself by no means took care of all of them. The analysis of the uses of algebra in other high school subjects, for example, was made by his group much more completely than were the earlier ones and it settles for a decade, perhaps longer, that particular question. The question of what are the mathematical reading needs of people, however, could have been attacked directly, for example, by a study of the newspaper and magazine reading of the general public. Mr. Thorndike's associates tabulated the extent to which readers of articles in the Encyclopedia Brittanica need to know mathematical terms and operations. Readers of these articles, however, are typical of the same small proportion of the total public that uses mathematics in college courses (and most of them never again). Hence his study throws light primarily on the elective courses of the senior high school and college, not on the courses to be required of all.

Beyond these studies of the uses of mathematics the investigations of the Committee and of the Thorndike group were not extended. From the Thorndike report one can obtain a direct interpretation of the data which deal with the topics of courses in algebra. Supporting its conclusions by evidence the Thorndike report analyses the extent to which the topics of conventional courses will be used. In this way it is possible to base curriculum recommendations on more than minority

opinion. The criterion is objective and for each topic answers the questions—Who will use it? How much use will be made of it? Thus the professional student of the curriculum is not blinded by the halo of the past. He is single-track minded to the extent that he recognizes only one great goal—namely, that of discovering what mathematical (or other) processes people need to take an intelligent part in the work and play of the world today. He postulates, at the start, both his and other people's inability to reach this goal from his own inner conscious processes. He believes that nothing short of an objective determination of people's activities will supply the details of the curriculum.

Objective Studies Are Needed of the Mental Discipline of Mathematical Instruction

Perhaps the reader is impatient with the attention which has been paid to the "uses of mathematics." No doubt the members of the National Committee themselves will be of that mind for they pin their faith greatly to another criterion for teaching mathematics—namely, mental discipline.

For a generation mathematics, like the classics and science and history and other subjects, has been taught because its sponsors believed it "trained pupils to think." A very large literature of opinion has been created to show that mathematics develops powers of logical thinking, that it brings about the ability to draw generalizations. Now, I personally think that the data of mathematics are peculiarly adapted to give pupils practice in drawing generalizations, that is to seeing relations between things which change together. But the more I study the data of the objective investigations of mental discipline, the more loath I am to choose subject-matter on the basis of a faith in "transfer."

The major curriculum question before us is not—Does training transfer? Of course it transfers. Thirty-five experimental studies provide the facts which one needs to form a judgment about that. The Committee itself has made the data conveniently available to teachers of mathematics. It has reprinted my detailed summary of the 29 studies which were published prior to 1915, and has also presented Miss Blair's excellent extension of that work thus bringing the data of the controversy over "transfer of training" completely up to date. Students of the problem will appreciate this work. Miss Blair also collected the judgments of psychologists who have worked

over the data of transfer. Summarized, these judgments say with varying emphases what was just said—"of course there is transfer."

But that is not the major curriculum question. Students of the curriculum face three other questions of discipline that are much more insistent than the academic one of training transfer. These questions are——First: Does the study of high school mathematics as now constituted increase one's ability to think? Second: If it does not, can high school mathematics be organized so that it will? Third, and most important of all: Is the increase in ability to think, which comes (or can come) from the study of mathematics great enough to require pupils to devote equal or more time to it—than they do to the problems of physical science, natural science, social science, literature and other esthetic subjects?

Now can any "committee" sit in judgment on these questions? It cannot, and for one very good reason: The necessary facts are not at hand or at least were not at hand in 1922. Will it not be granted that these three questions are fundamental and that they must be answered (and for each department) before we can make headway in the permanent reconstruction of the school curriculum?

How can they be answered? Certainly not by collecting the opinions of psychologists as to whether training transfers! On the contrary the first two questions can be answered by testing large numbers of children before and after one year, two years, three years or more years of instruction in mathematics. It is not asking too much of well-financed National committees in these days to expect them to do this. The tests are available and the technique of testing and statistical treatment is part and parcel of the equipment of curriculum specialists.

The National Committee did not attempt the answer to these questions. Mr. Thorndike did, although not as a part of his specific investigations of algebra. He did it as a separate inquiry. Fortunately for the readers of this article he presents his data in this current issue and the following issue of the Journal of Educational Psychology. He shows first, that one year's study of either algebra or geometry *as now organized* does increase one's ability to think—*by a small amount;* second, that the gain is no larger than that due to the study of other subjects, *as now organized.* Startlingly enough—bookkeeping, biology, cooking and sewing increase one's ability to think as much—even more in some instances than does the study of mathematics or the classics!

In this present writing we are not primarily concerned with the *findings* of these investigations. *It is on the methods employed by those who are engaged in reorganizing the curriculum that we are focusing our thought.* Mr. Thorndike's success in answering the first of our three questions is an impressive exhibit of the fact that the committee could have carried on objective studies of disciplinary values. To do it however their personnel would have had to be enlarged to include curriculum specialists. Is it not becoming clearer and clearer that the personnel of National Committees must include curriculum specialists? The National Committee could have set up important studies like that referred to which would by this time have supplied the answer to the second of our major questions of the disciplinary values of mathematics. The third question is much more difficult. We do not have the facts with which to answer it. They will be expensive to discover and difficult to interpret. Committees with funds to dispense can contribute greatly to the discovery of the facts by setting up extensive evaluations of both the social and disciplinary values of the major divisions of the school curriculum. Is the evidence not convincing that these evaluations must be made and that they must be objective?

Objective Studies Are Needed Concerning Problems of Experimental Teaching

There remains to be considered one of the most difficult phases of curriculum construction. I refer to the third of our major questions. Paraphrased it reads—How shall mathematics (or any other "subject-matter") be taught? A host of puzzling queries confronts us. Some deal with the problem of assignment of materials and activities to the grades of the school, others with their teaching arrangement. Here are three illustrations. Where shall the "introduction to algebra" be given? Shall the pupil first meet it in Grade IX as he has traditionally met it or in Grade VII as certain new text-books organize it, or even perhaps in Grade VI? In what schoo lgrades and through what graduation shall the notion of relationship be built up; the concept of correlation, functionality, dependence—call it what you will? Shall "signed numbers" be taught early or late in our elementary algebra instruction?

These are typical of the most difficult psychological questions which the curriculum-maker is called upon to answer. Are facts available with which to answer them. To answer some of them—

Yes; for most of them—No. A generation of teaching experience—wasteful on the whole—has taught us that certain "subjects" like albegra, or parts of subjects, can be learned in the ninth, or eighth or even in the seventh grades by pupils of particular degrees of verbal intelligence. To this day, however, there has been no systematic, controlled, and measured experimentation designed deliberately to solve these problems of grade-placement.

For each topic or item the major problem can be put simply: What is the earliest school grade in which this principle or process can be learned effectively and the learning of which at the same time will fit into the total graded scheme of instruction in that subject? This problem can be attacked directly and experimentally. All that is required is to teach the same operations to a large number of pupils in several adjacent grades, say VI, VII, VIII and IX, if tradition has already placed the material in, say, grade IX. The facts of the pupils' intelligences and their attainments can be determined objectively. That the experiment is difficult is not a sufficient reason for neglecting it. Its importance is paramount. The science of education has developed a technique which is adequate for its solution. It is becoming apparent that National Committees can command the financial resources to carry through such experiments. Is it not imperative that these national bodies organize the machinery of such experimentation?

What was the procedure of the National Committee on Mathematical Requirements? They did not set up, or endow grade-placement and teaching experiments. That will be regretted. They could have sponsored such experiments. To have done so would have greatly furthered the development of exact curriculum-construction in mathematics.

It is greatly to their credit, however, that they made no definite recommendations for grade-placement. They recommend the topics to govern instructional units but decline to advise as to teaching arrangement. The latter position is taken on the ground that the basic facts are not known. Their recommendations, optional in character, are permeated distinctly by an experimental atmosphere and should help create such an attitude on the part of mathematics teachers.

The Thorndike group likewise neglected *experimental* problems. The solution of problems of grade-placement and teaching arrangement of materials and activities was not undertaken. Very likely they could not be attacked with the resources at the group's command.

Teaching experiments, carried out on a scale large enough to supply substantial proof will be very expensive, will occupy the energies of a considerable body of trained and experienced experimentalists in the classroom and will extend over several years of continuous effort—probably not less than five.

As an important phase of this vast problem of experimental teaching we are confronted by the difficult task of interpreting and applying what we know about the psychology of learning. The National Committee, on Mathematical Requirements very properly no doubt, does not undertake the task. The task is one for educational psychologists. The problem is the complicated one of detecting and describing the nature of the abilities called into play in learning mathematics.

There are two ways to attack the problem. One is the method of experimental analysis and measurement. The other utilizes the application of current psychological thought to the analysis of the abilities involved. It is my confident judgment that both methods must be employed. To the present time only the former has been so used and that by the Thorndike group.

Both the Thorndike group and the National Committee describe, excellently, the tests that are now available for the use of teachers of mathematics. Professor Upton's very complete chapter is an excellent exposition and evaluation of the tests. But the Committee has not used the tests to evaluate results obtained from present instruction nor to analyze the constituent abilities of mathematical learning.

Again it is the students of education who did it. The Thorndike group not only presents new tests and evaluates old ones—it also evaluates results obtained from present instruction. One of the chief contributions of the study is Mr. Thorndike's analysis of the abilities which are called into play in algebra. He has followed the same procedure for algebraic learning that he developed in his *Psychology of Arithmetic*. The procedure first states what the abilities are that need to be developed; for example the ability to understand and frame formulas, ability with equations (including an analysis of the psychology of the equation), ability with problems (including the psychology of problem solving) and ability with graphs. Next the procedure states what contribution the current dynamic psychology can make to the perfection of habits involved in learning algebraic operations. It considers from a thoroughly inductive point of view such questions as: provisions for habits now neglected, the elimination of unnecessary habits, adaptable habits *vs* flexible rules, learning mean-

ings, learning algebraic computation, learning general principles, the selection of the mental connections to be learned and other related matters.

In the present undeveloped state of our science it is most important to have these analyses of the abilities which are utilized in *learning* our school materials. No more conspicuous illustration can be found in the two reports under discussion of the fact that National Committees must include in their personnel specialists in the study of the curriculum. Committees are obligated to discuss problems of teaching, hence problems of learning come within their purview.

More important, however, than the analysis of abilities is the discovery of how the abilities are developed. The Committee does not discuss the problem; Mr. Thorndike devotes 160 pages to it. Probably his chief contribution at this point is his analysis of the practice now given to the learning of algebraic operations and his study of the psychology of drill. The former is objective, and includes a count of the opportunities for practice offered in current school textbooks. The latter analyses teachers' inability to estimate how much practice should be given on particular operations and presents a new estimate of the amounts of practice that should be given.

The Crucial Need for Controlled Experimentation in American Education

These two studies of secondary mathematics bring out in sharp relief one of the most patent gaps in the development of the scientific study of education. Not a single *experimental* study is reported, either by the National Committee or by the Thorndike group. It is true that the Committee prints a 100-page description by R. Schorling, of the way mathematics is taught in 15 different schools. This is called "Experimental Courses in Secondary School Mathematics." The unit is improperly named however for only one of the enterprises discussed could be thought of as "experimental" (as the writer himself points out) and the description of that one is totally inadequate. This omission is not peculiar to these two studies under discussion—it is typical of the whole scientific movement in education.

The great foundations are doing a work of incalculable value by making possible the inventory of our school practices and to some extent, the objective analysis of them. But there is a dire need that they pay more attention to the subsidizing of *experimental* education. Mr. Throndike's studies illustrate one thing which they are now doing.

They are endowing laboratory analyses of existing conditions and the direct application of current psychological knowledge to the improvement of teaching. But this type of work, fundamentally important as it is, represents but one phase of the scientific study of education.

Is there in America today one scientifically controlled classroom experiment in mathematics? It is my confident judgment that there is not. Yet there are more than 50 public school systems in each of which there is in working order a "bureau of research," directed by a person trained in the technique of measurement and in most cases of experimentation. And it is practically impossible for an editor to discover for journal publication controlled classroom experimentation. Furthermore it is practically impossible to persuade graduate students in our schools of education to undertake dissertation problems in experimentation. Why? Primarily because it costs too much; it takes two or three years to complete one controlled experiment. Our major "research" energies are still devoted to giving tests and to presenting "norms."

The way out of our dilemma is clear. The educational foundations are spending large amounts of money on committee procedure and on laboratory analyses of educational processes. The mathematics report is by far the best report that has come from such endowment. Should it not be the last endowed committee report however in American education that does not carry on scientific studies of the abilities of children, of the needs of society and of the learning process?

In conclusion may the plea be made for the financing, by our great foundations, of a more complete and scientific program of procedure for National Committees? It is clear that these committees can render great aid in the improvement of school processes. Permanent reconstruction will be difficult without their services. Can they not however, be so constituted that their programs will be complete and will employ scientific technique?

The work of other National Committees, with large financial support, is about to be launched. What will be the procedure of these Committees?

To further the critical discussion of the matter there is reprinted in part an earlier proposal.

A Program for National Committees

A committee should act in three capacities if it wishes to improve school practice generally. First, it should act as a deliberative body

of specialists, stating educational aims and criteria; second, it should organize important investigations of social and psychological needs which underlie the curriculum; third, it should act as a national clearing-house and forum for controversial discussion.

A. The Committee as a Deliberative Body of Specialists Stating Aims and Criteria

The most important task of the committee is to draw up a scientific program for curriculum-making. This will necessitate frequent and prolonged round-table conferences.

The program should include, first, a definite statement of aims and outcomes of instruction; second, criteria for the inclusion of material in the courses, for assigning materials to school grades, and for presenting materials within grades. Such statements can be made only by getting the best composite judgment of trained specialists—a judgment which is the result of mature deliberation and round-table discussion. Two types of specialists should contribute to this discussion: (1) those trained in the study of the validity of materials, (2) those trained in the science of curriculum-making and educational psychology. It is inconceivable that a curriculum can be made properly by either group working alone.

B. The Committee as an Organizer of Investigations of Social and Psychological Needs

The program of a national committee, in the second place, should be investigational. Once the fundamental principles are established, detailed studies of human needs and results must be made. Five types of work appear to be important.

1. Determine the exact status of the present teaching in our public schools. This means an accurate compilation and interpretation of current courses of study from an adequate number of communities—certainly several hundred—selected so as to make a perfectly representative sample of the whole country on such matters as: (*a*) aims, objectives, and specified outcomes of instruction; (*b*) scope of the course which is covered in each grade; (*c*) time devoted to the subjects of each grade; (*d*) the precise materials used by the pupils—textbooks, activities employed, miscellaneous materials; (*e*) by the use of trained specialists, adequately financed, analyze by careful quantitative methods and interpret thoroughly the content of school textbooks and other materials and also class activities, actually in operation in

public schools. The purpose of this is to determine precisely the content and arrangement of our present curriculum. We must know definitely what present practice is in order constructively to evaluate it and scientifically to reconstruct it.

2. Evaluate critically and constructively the scientific investigations of curriculum-making in the subject under consideration that have already been published. In like fashion, borrow and make similar use of unpublished curriculum studies in our universities and schools of education. The findings of many such investigations are deposited in the libraries of universities like the University of Iowa, University of Chicago, Teachers College, Leland Stanford Junior University, and others.

3. Make and publish an exhaustive evaluation of representative examples of experimental courses. A score or more of important innovations can always be found among the thousands of schools and school systems. Scrutiny and careful weighing of the purposes, programs, and accomplishments of these new types of courses, some of which are truly experimental, are the most important functions of national committees.

4. Test objectively the results obtained from present instruction in a sampling of typical public schools by the employment of standard measures of attainment. This would reveal to what extent pupils have mastered great relationships, principles, and laws; to what extent they have developed a command of technique and have learned how to use it.

5. Make scientific investigations of social and psychological needs for the purpose of discovering what should be included in the courses, to what grades different materials should be assigned, and in what order and arrangement they should be presented. Such investigations should be delegated to expert collaborators—specialists trained in educational research. Similarly, the committee should endeavor to stimulate constructive research by others for the discovery of what ought to be taught and in what grades the material should be given.

C. The Committee as a Clearing-house and a Forum

It should stimulate controversial discussion by publishing and debating with school people generally its own programs, various other programs of work, different hypotheses concerning the selection and arrangement of subject-matter, theories of teaching, principles of organization, and the like. It should direct this discussion to the con-

sideration of big issues and important questions so that after some years both clear thinking and experimentation will make possible a widespread agreement on fundamental matters. It should get official sanction for, and give widespread publicity to, the findings obtained from the committee's careful investigations, deliberations, and decisions.

D. The Continuing Committee

As a continuing or standing body, once its recommendations are put into practice, it should study their application in public schools; collect reactions of school people to the proposed program; test results obtained by different organizations of material found by the committees to be socially valuable; finally, report these findings periodically to the school public.

THE ARMY RATING SCALE METHOD IN THE KINDERGARTEN

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In a recent comprehensive article on the rating of human character[1] Dr. Harold Rugg specifies three necessary conditions for satisfactory rating. They are (1) that each final rating given a person shall be the average of *three independent ratings*, each one made on a scale as objectified as the man-to-man comparison type of scale; (2) that the scales on which the ratings are made shall be comparable and equivalent, having been made in conferences under the instruction of one skilled in rating scale work; and (3) that the three raters shall be so thoroughly acquainted with the person rated that they are competent to rate. He then adds: "But these conditions are practically unattainable in public schools."[2]

Through the cooperation of the teachers, ratings of four groups of kindergarten[3] children in the Horace Mann School have been collected by the writer as School Psychologist. These afford valuable material for the study of the Army Rating Scale method in a school situation.

Details of the Method Employed

The Army Rating Scale method was first used by the kindergarten teachers in the spring of 1921, having been suggested by the writer in response to a request from Miss Agnes Burke,[4] then principal of the kindergarten, for a plan of rating the pupils in fitness for promotion which would be more satisfactory than the former method of ranking within a group. Hence the details of the plan were worked out wholly without reference to the three criteria suggested later by Dr. Rugg in the article mentioned. The success of the method led to its continuance the following year.

Although, as already stated, the experiment was undertaken before the publication of Dr. Rugg's study of the Army Rating Scale, the first and the third of the conditions of successful rating proposed by him were fully met, and the second, in part. Thus, in the first place,

[1] *Journal of Educational Psychology*, Vol. XII, pp. 425–438; 485–501; Vol. XIII, pp. 30–42; 81–93.

[2] Reference cited, p. 425.

[3] Or "junior primary," which is the term now employed.

[4] To whose initiative and interest the success of the experiment is largely due.

the final ratings given each child in all but a small number of cases were the result of at least three independent ratings, each made on the adaptation of the Army Rating Scale provided for the purpose. In the second place, the principal of the kindergarten was instructed in the use of the Rating Scale by the writer, who was thoroughly acquainted with the technique and had supervised the preparation of the instructions for the adaptation used, the other teachers being subsequently instructed by the principal. In the third place, the raters were teachers in the kindergarten who knew the children intimately, and hence were thoroughly competent to rate them in the traits selected.

The instructions for the kindergarten ratings were taken from an adaptation of the Army Rating Scale which had been prepared for the purpose of rating Sunday school pupils.[1] The traits on which the children were to be rated and the definitions of these traits are here given. They were formulated by the principal of the kindergarten in the spring of 1921,[2] and adopted by the other teachers of that year. They were accepted subsequently without revision by the teachers of the following year.

I. Habits of work.
   Ability to initiate or adopt projects and carry them out.
   Ability to fail and persevere.
   Ability to carry out directions of others.
II. Participation.
   Ability to contribute to the social development of the room.
   Ability to take an intelligent interest in the social activities.
   Ability to participate and be responsible for the social organization (the making and carrying out of rules).
III. Cooperation.
   Ability to work and play together (this refers to the spontaneous activities).

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[1] Under the direction of the writer by a student in a course in Scientific Method and Experimentation for Religious Workers in Drew Theological Seminary. See the Teacher's Rating Scale for Sunday School Pupils, described in "Some New Tests in Religious Education," by Clara F. Chassell, in *Religious Education*, Vol. XVI, pp. 318–336; reprinted as bulletin 21-C, published by the Religious Education Association, Chicago.

[2] The principal states that she was directly influenced in her selection of traits by the yearly qualitative record sheets which have been in use in the kindergarten for a number of years. The teachers record in writing several times during the year the progress made by each child in these and other traits. As a result, in the case of the judgments reported in this study, the teachers were rating their pupils in traits which they had been watching throughout the year.

Does he work and play by himself or does he work and play in a group—gregarious or cooperative?

In group activities has he ability to hold his own and does he show proper consideration for others?

IV. Responsibility.

Does he do his part in the general care of room?

Does he take care of his locker and personal belongings?

Can he be trusted to care for himself in such matters as putting on coat when going outdoors? Does he stay with group when taking excursions, crossing streets, etc.?

The scale used by the teachers consisted of three steps, 25 being the value assigned to the highest position, 15 to the middle, or average, position, and 5 to the lowest.[1] Hence for ratings in the four traits the range of the scale extended from 20 to 100, 60 points representing an average rating. Thus a fifth of the scale[2] would be equal to 16 points.

The Data Available for Study

As already stated, ratings were secured for four groups of children. These included the more mature groups of pupils for the years 1921 and 1922, numbering 58 children in both instances, 12 of the pupils in the less mature group for 1921, and the 24 in the less mature group for 1922.

The pupils were rated in each of the four character traits already described: Habits of work, participation, cooperation, and responsibility. The ratings were made independently by the teachers, and then combined.[3] For the 1921 groups all the original ratings in each of the four traits are available; for the 1922 groups, only the following were preserved: for the more mature group, the combined total ratings

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[1] A number of ratings below 5 were given to pupils in the less mature group for 1922, and a single rating below 5 in the more mature group for 1921.

[2] "To locate a person within his proper 'fifth' of the entire scale" was taken as "a sound and practical working criterion for rating" by Dr. Rugg (see the *Journal of Educational Psychology*, Vol. XII, pp. 425–426).

[3] The number of teachers rating each group will be found in the tables of correlations which follow. It should be noted that in these tables Group A designates the more mature groups, and Group B, the less mature.

In the case of the less mature group for 1922 the ratings were made independently and then combined, modifications being made in the ratings in conference after the independent ratings had been submitted. The ratings of the third teacher, who knew the children less intimately, were utilized less than those of the other two.

in the four traits, and for the less mature group, the combined total ratings in the four traits and the combined rating in each trait.

The Correlations Obtained and Their Interpretation

In order to determine the degree of relationship between various ratings of character traits, and the degree of relationship between character ratings and other measures of the pupils, a number of correlations have been computed.[1]

Table I presents the correlations and their probable errors for judgments of character traits made by three teachers for 54 pupils in the more mature group[2] for 1921.

Table I.—Correlations between Ratings of Character Traits Made by Different Teachers

Group A, 1921 54 Pupils, 3 Judges

Teachers	Habits of work		Participation		Cooperation		Responsibility		Total rating	
	r	PE	*r*	PE	*r*	PE	*r*	PE	*r*	PE
A and B	.43	±.08	.53	±.07	.59	±.06	.35	±.08	.65	±.05
A and C	.62	±.06	.67	±.05	.71	±.05	.57	±.06	.74	±.04
B and C	.66	±.05	.32	±.08	.57	±.06	.37	±.08	.69	±.05

The figures for individual traits in almost every instance show a marked degree of relationship between the judgments of any two teachers, those between Teachers A and C being uniformly high with relatively small probable errors. Naturally the correlations for total ratings are higher than those for individual traits. They are all exceedingly satisfactory: the average correlation for the column is .69, and the difference between the highest and the lowest correlation is only .09; moreover, the probable errors are all small.

The average correlations for the individual traits (.57 for habits of work, .51 for participation, .62 for cooperation, and .43 for responsibility) would seem to indicate that at least for pupils of this age cooperation is the trait most easily judged, and responsibility the least. Perhaps the early manifestations of responsibility are harder to

[1] The Pearson product-moment formula was used.

[2] Four pupils rated by only two teachers were not included in the calculations.

identify. It is possible, however, that the definition of the one trait may have been less satisfactory than that of the other.

Table II presents the correlations between ratings of character traits and the following measures: chronological age, mental age, and intelligence quotient. All four groups of pupils are represented.[1]

TABLE II.—CORRELATIONS BETWEEN RATINGS OF CHARACTER TRAITS AND CHRONOLOGICAL AGE, MENTAL AGE, AND INTELLIGENCE QUOTIENT

Measure	Year	Group	*N*	Number of judges	Habits of work		Participation		Cooperation		Responsibility		Combined total rating	
					r	PE	*r*	PE	*r*	PE	*r*	PE	*r*	PE
Chronological Age	1921	A	54	3	.17	±.09	.19	±.09	.26	±.09	.18	±.09	.23	±.09
		B	12	1	.....		.....		.....		.....		−.17	±.19
	1922	A	58	4	.....		.....		.....		.....		.05	±.09
		B	24	3	.75	±.06	.76	±.06	.61	±.09	.73	±.06	.80	±.05
Terman Mental Age	1921	A	54	3	.52	±.07	.35	±.08	.36	±.08	.41	±.08	.47	±.07
		B	12	1	.....		.....		.....		.....		.21	±.19
	1922	A	58	4	.....		.....		.....		.....		.23	±.08
		B	20	3	.40	±.13	.53	±.11	.68	±.08	.44	±.12	.55	±.11
Herring Mental Age	1922	A	42	4	.....		.....		.....		.....		.12	±.10
Terman IQ	1921	A	54	3	.34	±.08	.16	±.09	.13	±.09	.24	±.09	.26	±.09
		B	12	1	.....		.....		.....		.....		.28	±.18
	1922	A	58	4	.....		.....		.....		.....		.16	±.09
		B	20	3	.17	±.15	.31	±.14	.53	±.11	.20	±.14	.32	±.14
Herring IQ	1922	A	42	4	.....		.....		.....		.....		.13	±.10

The correlations between chronological age and character ratings are decidedly low for three of the four groups, being practically zero in one instance and negative in another. The results for Group B, 1922, are in striking contrast, and would seem to indicate that in the minds of the three teachers of this less mature group chronological age was a very important factor in evaluating the various character traits. The fact that the teachers were planning to select a limited number of

[1] Correlations for Group B, 1921, were included in the table in spite of the small number of cases and the large probable errors since in every instance they were found not to differ markedly from the figures for one or more of the larger groups.

these pupils for entrance into Grade I in the fall in company with the pupils in the more mature group, may have consciously or unconsciously added to their judgment of the importance of this factor. On the other hand, it is possible that in children with an average age of four years such traits as habits of work, participation, cooperation, and responsibility can hardly be identified apart from their manifestations due to experience and training, in giving opportunity for which chronological age would be a primary factor.

The correlations with mental age are also low for two of the groups, being practically identical (if the Terman Mental Age is taken as the measure) in the case of the less mature group for 1921 and the more mature group for 1922. The correlations for the other two groups, which are those showing the highest degree of relationship between character ratings and chronological age, are marked, and probably point to the influence of this factor.

Still more convincing evidence of the influence of chronological age on the correlations with mental age is afforded by the correlations with intelligence quotient, which are uniformly low (excepting the correlation with the one trait, cooperation, in the less mature group for 1922) for all four groups, and seem to indicate clearly that this factor at least can hardly be accused of casting a halo over the characters of the kindergarten pupils in question. It is of interest to note in passing that the correlations with mental age and intelligence quotient with the Herring Revision as the measure, are in both instances the lowest of any reported.[1]

The probable errors for all the correlations are also given in the table. Those for the two large groups of pupils are exceedingly close and uniform, whatever the size of the coefficient, ranging from $\pm.07$ to $\pm.09$ in all cases except the two correlations for the Herring Revision. The probable errors for the two smaller groups, with the exception of those for chronological age for the less mature group of 1922, are more variable and in general larger, as would naturally be expected.

There remain yet to be reported two correlations obtained for the pupils of Group A, 1921, between the combined total rating for the three teachers of that year and the scores given on a citizenship scale[2] by

[1] The correlation between the Stanford (Terman) and the Herring Revisions was .85 ($\pm.03$) for the 42 cases.

[2] The measure used was the Chassell-Upton Short Scale C. For a reproduction of the scale and instructions for rating, see Chassell, Clara F.; Upton, Siegried M.; and Chassell, Laura M.: "Short Scales for Measuring Habits of Good Citizenship," *Teachers College Record*, Vol. XXIII, pp. 52–79.

the teachers of these same children a year later. For the 19 children who became pupils of Teacher A in Grade I the following school year the correlation was .57 (±.10); and for the 22 children of this group who became pupils of Teacher B, the correlation was .50 (±.11).

The purpose of this citizenship scale is to provide a quantitative measure of habits and attitudes desirable for good citizenship in the school community. Since the teachers who used the citizenship scale for rating their pupils knew that their ratings were to be incorporated in the data assembled for determining spring promotions, as did the teachers of the preceding year who used the Army Rating Scale method, it is probable that the mind-set of the two groups was similar.

In view of these fairly high correlations the conclusion is unescapable that the three teachers of the more mature group of kindergarten children for 1921, utilizing the Army Rating Scale method, were decidedly successful in predicting the status of desirable habits and attitudes in their pupils a year later, as judged by a single teacher using an entirely different method of measuring character traits.

The Comparability of Ratings by Different Judges

In Table III are presented the data available for a study of the comparability of the total ratings made by different judges. The 54 children in Group A, 1921, marked by three teachers, constitute the group under consideration.

Examination of the original ratings for these pupils, given in the first three columns of the table, shows frequent instances of considerable disagreement between the three ratings of an individual pupil, although in general they are fairly close.[1] Moreover, investigation of the 162 cases of paired ratings (*i.e.*, the 54 each for Teachers A and B, A and C, and B and C) shows that there are 36 instances of a divergence of 16 points or more. These amount to 22 per cent of the total number of comparisons. Since the total scale is 80 points, it is apparent that when judgments of only two of the teachers are utilized the disagreement between ratings amounts to one-fifth of the entire range in slightly more than one-fifth of the 162 cases of comparison. The number of divergences of this magnitude for each pair of teachers is as follows: A and B, 14; A and C, 16; and B and C, 6. The number of plus and minus divergences is about equal in the first instance; in

[1] The correlations for these data have already been reported in Table I. They are as follows: for Teachers A and B, .65; A and C, .74; and B and C, .69.

TABLE III.—ORIGINAL RATINGS, AVERAGE RATINGS, AND AVERAGE DIFFERENCES BETWEEN RATINGS

Key number	Teacher's rating			Average rating	Average difference between ratings	Key number	Teacher's rating			Average rating	Average difference between ratings
	A	B	C				A	B	C		
1	40	50	55	48.3	10	31	53	50	65	56	10
2	53	45	71	56.3	17.3	32	41	65	54	53.3	16
3	38	50	66	51.3	18.7	33	60	65	74	66.3	9.3
4	84	75	90	83	10	34	80	75	89	81.3	9.3
5	69	65	70	68	3.3	35	75	70	80	75	6.7
6	65	60	62	62.3	3.3	36	55	75	52	60.7	15.3
7	76	78	65	73	8.7	37	78	60	72	70	12
8	55	65	78	66	15.3	38	49	82	73	68	22
9	50	55	49	51.3	4	39	75	70	90	78.3	13.3
10	48	50	57	51.7	6	40	28	45	35	36	11.3
11	84	60	67	70.3	16	41	85	75	90	83.3	10
12	55	55	42	50.7	8.7	42	61	60	54	58.3	4.7
13	28	45	35	36	11.3	43	71	70	83	74.7	8.7
14	67	70	83	73.3	10.7	44	30	45	48	41	12
15	58	65	77	66.7	12.7	45	52	55	52	53	2
16	75	65	69	69.7	6.7	46	83	80	93	85.3	8.7
17	60	65	76	67	10.7	47	43	60	62	55	12.7
18	32	65	62	53	22	48	46	60	56	54	9.3
19	72	65	79	72	9.3	49	58	55	74	62.3	12.7
20	52	70	75	65.7	15.3	50	73	70	82	75	8
21	52	70	72	64.7	13.3	51	65	60	45	56.7	13.3
22	50	60	65	58.3	10	52	73	70	83	75.3	8.7
23	80	65	71	72	10	53	73	85	86	81.3	8.7
24	85	80	92	85.7	8	54	47	70	63	60	15.3
25	84	75	77	78.7	6						
						Average...	60.1	64.2	67.9	64.1	10.6
26	34	55	36	41.7	14	Range....	28–85	45–85	35–93	36–85.7	2–22
27	69	65	73	69	5.3						
28	68	70	78	72	6.7						
29	47	55	45	49	6.7						
30	64	80	75	73	10.7						

the remaining two instances the number of plus differences greatly exceeds the number of minus differences. Ranges of the divergences for the corresponding pairs of teachers are from −24 to +33, from −20 to +30, and from −23 to +26; and the average differences, 10.1, 11.6, and 9.9, respectively. An average of these three last figures is found to be within one point of an average of the figures found by Rugg for two ratings by the same rater in the case of first and second lieutenants

and captains, and 6.4 points better than a corresponding average of his results for two ratings by different raters.[1]

When the average differences between ratings for the three teachers are considered, it is found that in only 6 cases out of 54, or 11 per cent, is the divergence between ratings equal to one-fifth of the total range of the scale. Thus the addition of a third judge has reduced the number of serious discrepancies exactly 50 per cent. The average of these differences for the 54 cases is 10.6, and the range, from 2 to 22. The probable error of this average is 2.91. In general, then, this group of pupils would seem to be placed within their appropriate seventh of the total scale, and in the most extreme cases of divergence are not displaced as much as two-sevenths of the total scale. Moreover, when three ratings as satisfactory as these are available, the chances are approximately 4 to 1 that the average difference between ratings in the case of any given pupil will not exceed 16 points, or one-fifth of the total range of the scale.

The question naturally arises as to the equivalence of the scales used by the three teachers. Their average ratings are as follows: A, 60.1; B, 64.2; and C, 67.9. It will be recalled that a theoretical average rating on the scale used is 60 points. Accordingly, none of the judges is markedly at variance with this standard, and Teacher A has maintained it almost exactly. The other two teachers are apparently less exacting in their judgments, or have made a less satisfactory selection of children for the middle position on their scales.

The range of the ratings for the three teachers shows less uniformity. It is as follows: A, from 28 to 85; B, from 45 to 85; and C, from 35 to 93. Only the discrepancy at the lower end is serious, however. Moreover, it should be noted that the three teachers have all agreed in assigning the lowest total rating which they saw fit to give, to two separate children. In view of the composite nature of this total rating, which is made up of separate ratings in four traits, this unanimity is remarkable and clearly shows that the two children are markedly inferior to their comrades in these traits. Examination of the original ratings in the four traits shows that the giving of identical total ratings to these two pupils by each of the three teachers is a coincidence, for the ratings assigned from trait to trait vary and are not identical for the two children for all four traits in the case of any one teacher.

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[1] *Journal of Educational Psychology*, Vol. XII, pp. 435–436.

Obviously the equivalence in ratings for the three teachers, relatively satisfactory though it is, could be increased by a statistical equating of the scales used, which the large number of cases rated by a single teacher would make easily possible.[1]

The average rating by the three teachers for the 54 pupils is 64.1, and the range of the average ratings from 36 to 85.7. The probable error is 8.38. Thus the actual average rating closely approximates the theoretical average rating. Moreover, the ratings have been distributed over approximately five-eighths of the possible total range of the scale. The range of the three ratings for the 54 pupils is as much as 16 points in 24 instances, or 44 per cent. The smallest range is 3, and the largest 33. The average of the ranges for the 54 cases is 15.9, which is one point better than the average of the range found by Rugg for all persons rated by three or more very well qualified raters in his general conference group. The average of the average deviations for the 54 cases is 6.1, which is two-tenths of a point better than the best corresponding result found by Rugg for all persons rated by three or more raters.[2] In view of this last figure, the chances are probably about 4 to 1 that any given rating will be within 12 or 13 points of the person's true rating, and thus well within his proper fifth of the total scale.

In conclusion it may be said that the ratings for this group of kindergarten children represent as accurate a judgment of pupils as one is likely to obtain in the most favorable school situations, and one that fully meets any requirement for careful rating that is likely to arise.

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[1] Using the method outlined by Rugg in the *Journal of Educational Psychology*, Vol. XII, pp. 489–490.

[2] *Journal of Educational Psychology*, Vol. XII, p. 487.

NOTES ON ARTICLES IN EDUCATIONAL PSYCHOLOGY IN CURRENT ISSUES OF OTHER MAGAZINES

Intelligence Tests

A Combination Mental Test for Clinical Use. Grace H. Kent. Journal of Applied Psychology, 1923, September, 246–237. Discusses the limitations of the Stanford Revision of the Binet for clinical use. Proposes an indefinite series of short-time tests, both verbal and performance, as a substitute for a fixed scale of tests.

The Status of Mental Testing in Colleges and Universities in the United States. Donald A. Laird. School and Society, 1923, Nov. 17, 594–600. Summarizes the answers to a questionnaire sent to 43 state schools, 43 denominational schools and 21 private schools of collegiate grade. Reports the schools carrying testing programs, the tests used, the uses made of test results, and the general attitude toward testing.

Freshman Tests in the Small College. Elsie Murray. Journal of Applied Psychology, 1923, September, 258–276. Records from Sweet Briar College over a period of three years show the predictive value of the Thurstone Psychological Examination for College Freshmen.

Intelligence and Persistency in High School Attendance Gustave A. Feingold. School and Society, 1923, Oct. 13, 443–450. A study of records at the Hartford Public High School shows that only 19 per cent of the lowest mental group enter the senior class as compared with 80 per cent of the superior pupils. Emphasizes the need for a school of practical arts.

The Effect of Bilingualism on Intelligence. D. J. Saer. British Journal of Psychology, 1923, July, 25–28. Various tests used with rural school children in Wales and university students from rural districts show considerable superiority in intelligence among the monoglot groups.

The Social and Geographical Distribution of Intelligence in Northumberland. James F. Duff and Godfrey H. Thomson. British Journal of Psychology, 1923, October, 192–198. Summarizes and discusses results from the intelligence tests of 13,419 children. In general, the average IQ increases with social standing and residence in towns.

Influence of Mental Level in the Formation of Boys' Gangs. M. La Vinia Warner. Journal of Applied Psychology, 1923, September, 224–236. A study of 13 groups and 7 pairs of boys comprising 66 different individuals indicates mental age as the greatest factor in the selection of one's companions and in holding groups together.

View of Teachers on the Sectioning of High School Classes on the Basis of Intelligence. Gustave A. Feingold. Educational Administration and Supervision, 1923, November, 467–486. The results of a questionnaire answered by 33 teachers show segregation on the basis of intelligence to be very popular. The advantages to pupils, teachers and administrators are discussed.

Distinctive Ability. Truman L. Kelley. School and Society, 1923, Oct. 13, 424–428. Statistical analysis of test results shows that many so-called separate tests are identical in function. Enumerates eight separate abilities which can be genuinely distinguished in an individual.

Educational Tests

Measurement of a New Phase of Reading. Clifford Woody. Journal of Educational Research, 1923, November, 315–326. Describes a reading scale based upon ability to pick out the central thought of a paragraph.

The Woody-McCall Mixed Fundamentals Test and Arithmetical Diagnosis. Paul V. Langren. Elementary School Journal, 1923, November, 206–215. An analysis of 2950 errors in arithmetic made by pupils in Grades III to VIII. Questions the diagnostic value of the test.

A Study in Reading Diagnosis. Ruth Geiger. Journal of Educational Research, 1923, November, 283–300. Reports a study of the reading difficulties of a third grade as determined by standard tests. Case studies show individual needs and the remedial measures used.

Fluctuations in Mental Production When Motivation Is the Main Variable. F. B. Knight and H. H. Remmers. Journal of Applied Psychology, 1923, September, 209–223. Genuine motivation offsets fatigue and produces twice as much work. Reports an interesting comparison between test work done by juniors with ordinary classroom motivation and freshmen physically tired but strongly motivated.

Miscellaneous

A Grading and Promotion Plan Based on the Use of Intelligence and Educational Tests. Ford R. Park. Elementary School Journal, 1923, November, 219–226. Intelligence tests plus teachers' judgments as a basis for grouping and educational tests for promotion. The advantages and the difficulties of the scheme.

Recent Progress in Educational Research. W. W. Theisen. Journal of Educational Research, 1923, November, 301–314. Summarizes under the two headings of Instructional and administrative Research the main contributions in each field and suggests other investigations that are greatly needed.

The Value of Knowing the Child's Biography. Alice B. Allen. Educational Review, 1923, December, 262–265. The responses of 70 ninth grade pupils to a questionnaire asking facts about age, school attendance, health, attitude toward curriculum, idea of typical high school student, kind of teacher liked best, and names of books greatly enjoyed show the value of such information in judging the individual child.

A Case for the Education of the Gifted. Herbert D. Bixby. Educational Review, 1923, December, 258–260. Cites reasons for devoting special attention to the education of individuals endowed with gifts of intellect and ability for leadership and service.

Problem Children in the Early School Grades. C. Elizabeth Dealey. Journal of Abnormal Psychology and Social Psychology, 1923, July–September, 125–136. Reports a study of 38 children in Grades I to III, classified by teachers as "backward," "nervous" and "shy." Each child was studied individually. Two cases are reported in detail. Data for the 38 cases are summarized under the headings—(1) heredity, (2) environment, (3) physical health.

Children's Empty and Erroneous Concepts of the Commonplace. Flora Scott and Garry C. Myers. Journal of Educational Research, 1923, November, 326–334. A study of the responses of 173 children, Grades V to VIII, shows that common terms in history and geography are used constantly without any real knowledge of their meaning.

On a Certain Statistical Danger. H. T. Manual. Educational Administration and Supervision, 1923, November, 465–466. Warns against too much emphasis on the group and not enough attention for the individual.

The Prediction of Teaching Success for the College Student. Edward S. Jones. School and Society, 1923, Dec. 8, 685–690. Discusses four types of criteria predictive of successful teaching—grades in college work, outside activities, intelligence test scores, and subjective ratings by teachers and students.

Elementary School Children and the Movies. J. W. Groves. School and Society, 1923, Dec. 1, 659–660. Seven hundred and fifty-four public school children in a small California town answered questions as to attendance at movies. Three tables give data. Conclusions are listed and discussed.

The Gains Made in Ability in English by Pupils Who Study Latin and by Pupils Who Do Not. E. L. Thorndike. School and Society, 1923, Dec. 8, 685. Two tables of data correct measurements given in two early reports in School and Society —Jan. 20, 1923 and Feb. 10, 1923.

Experiments on the Problem of Mirror Writing. Lucy G. Fildes. British Journal of Psychology, 1923, July, 57–67. Reports procedure and statistical results of six experiments. Discusses and summarizes conclusions from data.

NEW PUBLICATIONS IN EDUCATIONAL PSYCHOLOGY AND RELATED FIELDS OF EDUCATION

CONDUCTED BY LAURA ZIRBES[1]

The Determination of High School Curricula

Curriculum Making in Secondary Schools, by J. A. Clement. New York: Henry Holt and Co., 1923. Pp. 534.

The greatest recent advances in the improvement of high schools have been made in schemes for organization and administration, social education, and effective teaching, while the fundamental problems of aims and subject-matter have been largely neglected. There has been gradual and marked improvement in the content of textbooks; and to the scholarly work of Bobbitt, Bonser, Charters, and Cox is now added an extended volume by Clement.

The purposes of the author are fully stated on pages 5–6: "One of the specific purposes of this treatise is to set forth a point of view relative to curriculum making in secondary schools which is dynamic and functional. In terms of curricula, this means that the content of the subject matter offered must be determined by the fundamental changing needs, activities, and experiences of individuals in groups, large and small. To stimulate each teacher of high school subjects to become aggressively interested in the common objectives applicable to all subject matter taught, as well as to become interested in analyzing specific aims involved in the teaching of his or her own special high school subject is a second purpose. To point out, by implication at least, that curriculum construction and administration is more than a one-man or single-administrator affair, is a third. It is a cooperative project to be worked out complementarily by the whole competent teaching body conjointly with one or more other leading educational experts and school officers. To indicate that curricula should be more scientifically formulated is a fourth. Such formulation involves a

[1] All unsigned reviews were prepared by L. Z.

complex of factors and principles, whether thought of in conjunction with private experimental schools, or in conjunction with progressive public secondary schools."

The volume is divided into four parts, though they are not indicated in the table of contents or the *format:* I. The relation of educational theory and practice, in which adaptation to individual differences is especially stressed; II. A comparative and historical study of curricula, sketchy and not brought up to date; III. The reconstruction of the content of the several subjects; and IV. Current practices and tendencies in curriculum organization. There are also three short appendices, which might better have found a place in the body of the book.

Clement would be the first, no doubt, to admit that the book contains little that is new in curriculum theory. But it does collect, especially in the nine chapters of Part III, a great deal of interesting and important matter, quoting liberally, and appending select bibliographies. Each chapter in the book is followed also by "information and drill exercises," mostly in the form of completion tests, and a number of "reflective and research problems," with blank spaces for supplementary exercises and additional references. As this indicates, the volume is intended rather for classroom use than for the advanced student of the subject. For this purpose it should find a wide welcome.

It is to be hoped that this volume, along with other recent publications, is an indication of increasing interest in curriculum problems. We need not only such researches in the proper content of the special subjects as are being carried on in the University of Chicago Laboratory Schools and in the Lincoln School of Teachers College for the social studies and mathematics, but also consideration of the curriculum as a whole. How little has been done to determine relative values, the placement of studies by years, and the distribution of time, to mention but three topics; and yet every school is called upon each year to make definite curricula for its pupils.

THOMAS H. BRIGGS.

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Columbia University.

How Shall We Measure the Dynamic Traits?

The Will-Temperament and Its Testing, by June E. Downey. New York: World Book Company, 1923. Pp. 339. Cloth.

Dr. June Downey presents in this book a systematic account of more than ten years of experimentation with various methods of plotting the pattern of the dynamic qualities. Her work has been described in several magazine articles, but no complete account of its general setting has appeared.

In her book we have a description of her will temperament tests and an evaluation of other methods of measuring the so called character traits. The tests purport to measure 12 personality traits named by the author as follows: Speed of Movement, Freedom from Load, Flexibility, Speed of Decision; Motor Impulsion, Reaction to Contradiction, Resistance to Opposition, Finality of Judgment; Motor Inhibition, Interest in Detail, Coordination of Impulses, Volitional Perseveration.

Miss Downey summarizes very carefully and interestingly the attempts that have been made to measure objectively the non-intellectual traits. She also reviews the work that has been done on rating scales and points out the necessity of using ratings with great caution.

The basis of the will temperament testing is "writing under distraction of attention." Miss Downey was led to use handwriting as a means of investigating these traits by the results of her earlier studies of "muscle reading," "mind reading," and the "psychology of handwriting." She bases her work on the fact that certain mental and emotional states are accompanied by involuntary movements. In her book, Dr. Downey reports a very critical account of years of experimentation with such facts. In this work it appears very clear indeed that she has not been swayed by the sweeping claims and conclusions of graphologists and other pseudo-experimentalists.

The book presents, with some excellently drawn graphs, examples of typical "profiles" drawn from scores made on her tests. There is the mobile type; the mobile-aggressive type; the non-specific type; the lower level type, etc. Dr. Downey presents a partial exhibit of the extent to which the profiles are good measures of what individuals actually are as judged by their associates. In company with several

of my associates, I am skeptical of the extent to which the will temperament tests actually measure the qualities of personality indicated by the Downey labels. For similar reasons many people will be glad to study the evidence presented in the chapters entitled "Testing the Will Temperament Test," "The Identification of Will-Profiles" and "The Will-Profile and Self Ratings." In these three chapters Dr. Downey throws considerable light on what the tests test. She summarizes fairly the investigations in which others have found correlations between scores on the will temperament tests and ratings. Almost without exception the correlations found by other workers are so low as to indicate that the tests and ratings do not measure the same traits. However, it is clear of course that most ratings of a trait are inadequate measures of it. Certain other criteria have been used and Dr. Downey discusses these. She also shows in the chapter on the "Identification of Will-Profiles" the extent to which persons tested can identify their own profiles. It appears to be clear that, in from one-third to one-half of the cases, the profiles and the subjects' estimates of themselves agree. In the other half they do not.

In addition to discussing the foregoing topics, the author considers each test in detail, likewise the trait which it is designed to measure. She also reports typical profiles of psychotic and psychopathic subjects, the relation between subject and will-temperament, the extent to which specific habits, age, intelligence, and sex, influence scores on the tests; how the intelligence test can be supplemented by a will-temperament test; the relation between the quality of intelligence and temperamental pattern, and the practical use that can be made of will temperament testing.

Although I did not agree with the commercial distribution of the Downey Tests at the time they were first published by the World Book Company and still believe that it is an example of premature commercialization, it seems to me that Dr. Downey's book is a helpful contribution and that it will advance the study of the dynamic traits. It is very interestingly written. It is a little too technical for the rank and file of teachers. However, the large army of graduate students in our courses of advanced psychology can read it with profit. I feel confident that it will serve to divert some of the research ability of the country from the routine study of intelligence and educational testing to which our major efforts are now directed. It has been clear for some time that we need to recognize that verbal intelligence represents only one-fifth or one-sixth or one-eighth of human person-

ality. The objective measurement of character traits will further our proper orientation.

HAROLD RUGG.

OBJECTIVE VERSUS CONVENTIONAL WRITTEN EXAMINATIONS

An Investigation of the Written Examination as a Measure of Achievement with Particular Reference to General Science, by J. Bardy. Philadelphia: University of Pennsylvania, 1923. Pp. 176.

Recently, McCall, Monroe and others have stressed the importance of the informal objective examination as a substitute in part for the traditional type. This dissertation is a significant contribution applied to a recently introduced subject, wherein the influence of recent scientific tendencies is of special interest.

The author's first approach is a questionnaire investigation of prevailing practice with respect to written examinations in 236 high schools in all parts of the country. An interesting analysis of the data and of a large number of sample examinations and sets of papers submitted by the teachers, reveals the typical traditional examination situation, unameliorated by use of intelligence or standard tests. The omission of questions relative to the probable use of informal objective tests is to be regretted.

In an experiment with 291 ninth grade boys, the Terman and Army Alpha group tests were given, followed by a parallel series of conventional and new type tests in General Science, covering practically identical content, for the purpose of comparing the two types as measures of achievement.

The correlations of each type of test with the group intelligence tests as criteria of "educability" reveal a more constant and somewhat higher correlation in favor of the new type (0.59 *vs.* 0.47). The results, similar to those secured by Wood with college freshmen, are suggestive, but admittedly inconclusive. A clearer differentiation between reliability and validity and a more extensive and refined statistical treatment would seem desirable, especially in connection with the sampling in the conventional examination.

The addition of an excellent survey and the inclusion of original tests make this volume of particular interest to schoolmen contemplating a modification of examination practice.

J. KUDERNA.

The Lincoln School of Teachers College.

Curriculum Studies for the Elementary School

Home and Community Life, by Gertrude Hartman. New York: Dutton, 1923. Pp. XII–200.

Those who have read or rather used "The Child and his School," by the same author, will know what to expect in this volume when told that the emphasis is reversed. In the earlier publication the greater part of the work is devoted to the presentation of source quotations from the writings of psychologists and educational philosophers, and to statements of principles of progressive educational practice. In this book the point of view seems to be taken for granted. Fourteen pages are deemed a sufficient introduction to parts one and two which contain concrete suggestions "for the organization of the curriculum as an instrument for interpreting the world to the child," and copious references for classroom use in the development of each topic and subtopic.

Except in the introductory pages the material is presented in outline form. There is no attempt at grade placement and no suggestion as to appropriate activities or methods, although it is definitely assumed that subject-matter should be embodied in purposeful group activities. The aim has been to select a core of subject-matter which should come into the possession of every child as a result of his school experiences. The author suggests the feasibility of using numerous pertinent sources rather than a single text and facilitates matters by giving numerous chapter and page references for about seventy topics. The vagueness and superficiality which too often characterize departures from the formal features of prevailing practice may be reduced or eliminated by the judicious use of such well selected references. Thus Miss Hartman has rendered progressive education a signal service which enthusiastic but busy teachers will welcome and appreciate. Those who desire guidance in the selection of reference libraries for elementary schools will also find this book invaluable.

New Conceptions of Conduct and Personality

Personality and Social Adjustment, by E. R. Groves. New York: Longmans, Green and Co., 1923. Pp. IX–296.

Recent progress in the understanding of human nature has been rapid. Much has been done and much has been written but there has

not been time for a careful selection and organization of the findings. While many of the problems are still matters of dispute, enough is known to make a more or less general and practical presentation timely. This author traces the historical development of his theme briefly. He then shows the relation of impulses to social control, of instincts to complexes, of habits to social continuity. The book is manifestly written for those who are engaged in work with children, but the author does not fail to indicate the broader social implications of emotional conflicts. This fact gives the whole discussion added significance. The writer implies that there is no necessary conflict between the adjustment of the individual and wholesome social conduct. The problems of abnormality do not receive the morbid overemphasis which too often results in distorted views.

The wholesome emphasis on the conduct problems of normal members of society should secure for the book a wide circle of influence and give it a large measure of usefulness, both for general readers and as a college text. At the end of each chapter the latter purpose is also served by the inclusion of lists of stimulating problems for class discussion, and topics for individual investigation and report. Carefully selected page and chapter references will be appreciated by those who are weary of the search for "needles in haystacks."

The "Case" of the Pre-school Child

Mental Training for the Pre-school Age Child, by Lillian J. Martin and Clare de Gruchy. San Francisco: Harr Wagner Publishing Company, 1923. Pp. 108.

Parents and teachers will find these excerpts from the experiences of a consulting psychologist of practical value in the training of children. The mental hygiene of the very young child resolves itself into a problem of the education of parents. The book is therefore properly an attempt to give parents a sound and sane explanation of the causes of undesirable behavior, and constructive advice and help in the solution of problems of guidance and early training.

Chapter one presents a "Mental Health Questionnaire" which is used to secure data from parents. The replies are often highly indicative and enable the consultant to diagnose and prescribe. Practically every chapter starts with a rule, shows its significance, and then illustrates its application by reference to a number of typical instances or cases.

Parents and teachers are too prone to view the child's behavior as a matter for which the child is chiefly or solely responsible. They have often been somewhat loath to admit the possibility of improving the child's reactions by revising their own conduct or adjusting the environment to the child's needs. This book should help such parents and teachers as well as those who are willing but unable to recognize the early forerunners of serious misconduct, unhappiness and maladjustment.

Problems of Reeducation

Nervous and Mental Reeducation, by S. I. Franz. New York: Macmillan, 1923. Pp. IX–221.

This volume has direct significance for those who are engaged in work with handicapped children or adults. Specific suggestions as to five types of nervous and mental re-education are preceded by a definition of the process and a statement of general principles and methods. There are several chapters on the treatment of maimed and crippled children and adults, a chapter on the treatment of speech defects, and another on the reeducation of the psychotic. While the author's approach to the problem is thoroughly scientific, the discussion is not over technical, and the suggestions are concrete and practical.

L. Z.

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Parents and teachers are too prone to view the child's behavior as a matter for which the child is chiefly or solely responsible. They have often been somewhat loath to admit the possibility of improving the child's reactions by revising their own conduct or adjusting the environment to the child's needs. This book should help such parents and teachers as well as those who are willing but unable to recognize the early forerunners of serious misconduct, unhappiness and maladjustment.

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